Radiological Health Data

VOLUME III, NUMBER 4
APRIL 1962

QUARTERLY REPORT

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis and interpretation of data on environmental radiation levels. The Department delegated this responsibility to the Division of Radiological Health, Public Health Service.

Radiological Health Data is published by the Public Health Service on a monthly basis. Data are provided to the Division of Radiological Health by other Federal agencies, State health departments, and foreign governments. Except where material is directly quoted or otherwise credited, summaries and abstracts are prepared by the Radiological Health Data and Reports Staff, Division of Radiological Health. The reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

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RADIOLOGICAL HEALTH DATA

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Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations at urban locations operated by State and local health department personnel, except for 2 stations which were operated by Public Health Service personnel. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network was expanded over a period of a few months to 63 stations (see figure 1).

Air

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone.

Daily air samples are collected continuously by a high volume air sampler with a carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the operator to estimate the amount of beta activity of particulates in air at the station five hours afer collection by comparison with a known radioactive source. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network for a more refined measurement using a thin-window gas flow proportional counter. Table 1 presents the monthly summary report of fission-product gross beta concentrations in surface air during January 1962. The data shown represent the activities extrapolated to the time of collection.

Precipitation

Continuous sampling for total precipitation is conducted at each station on a daily basis using locally-made funnels having collection areas of 0.4 square meter (m^2). One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples.

The monthly averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per square meter ($\mu\mu c/m^2$), are presented in tables 2 and 3 for December 1961 and January 1962 respectively. The total precipitation for the

month, expressed in millimeters, may be computed directly from the data by using the following expression:

$$\text{Total precipitation (mm)} = \frac{\text{Total activity } (\mu\mu c/m^2)}{\text{Average concentration } (\mu\mu c/\text{liter})}$$

When the gross beta concentration of a given daily precipitation sample is too low for reliable measurement, an activity ($\mu\mu c/m^2$) calculated from the minimum level of detection is included in the monthly summation of activity. In the event that the sum of such "less-than" activities is greater than one-tenth of the total gross beta activity for the month, the monthly activity is reported with a less-than (<) sign.

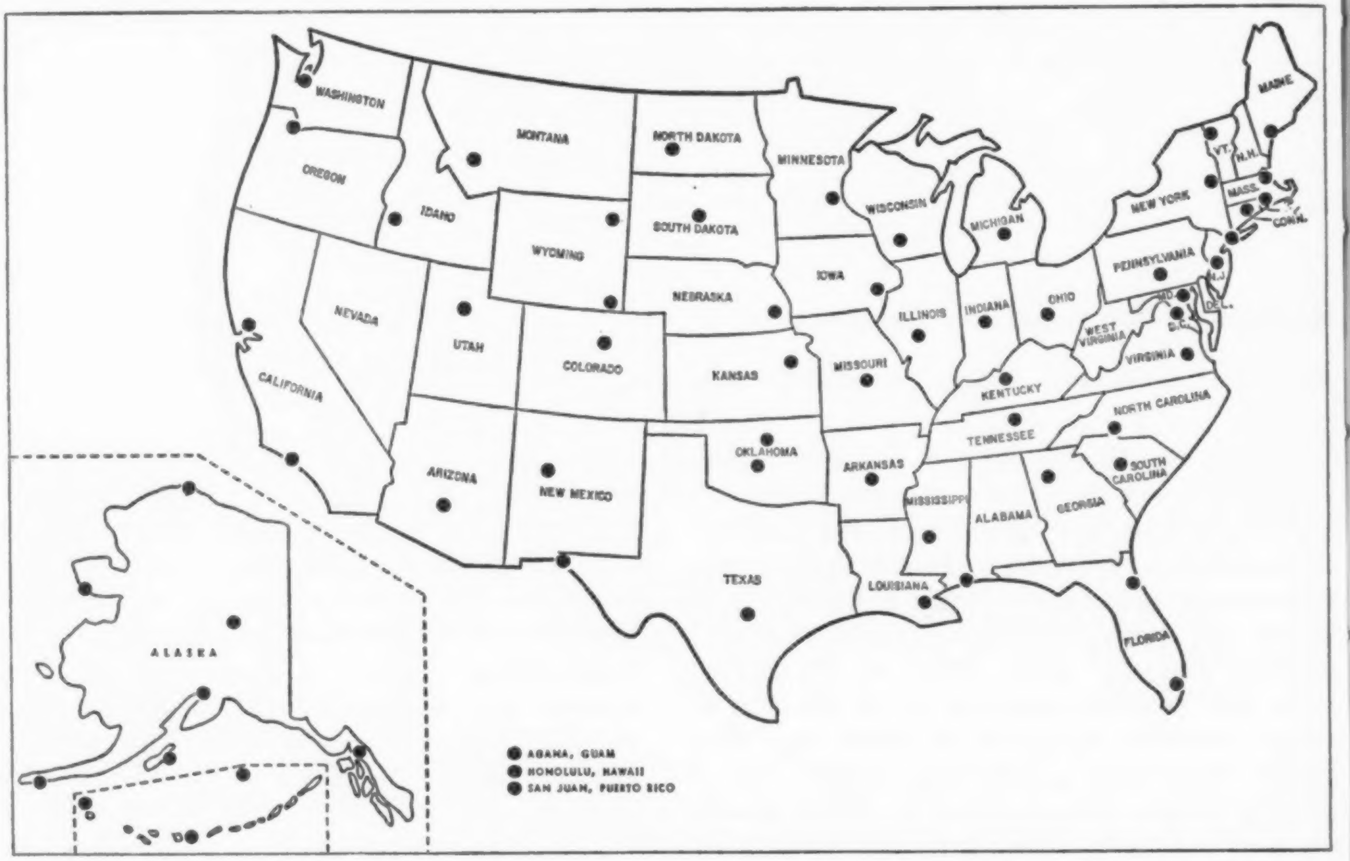

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS, JANUARY 1962

TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, JANUARY 1962

[Concentrations in $\mu\mu c/m^3$]

Station location		Number samples	Maximum	Minimum	Average[1]	Station location		Number samples	Maximum	Minimum	Average[1]
City	State					City	State				
Adak	Alaska	27	16	0.70	5.6	Lansing	Michigan	29	20	3.8	9.2
Anchorage	Alaska	27	18	1.1	6.2	Minneapolis	Minnesota	26	9.0	2.8	4.7
Attu	Alaska	22	10	0.20	4.4	Jackson	Mississippi	25	12	1.6	5.7
Cold Bay	Alaska	28	9.4	<0.10	4.5	Pascagoula	Mississippi	21	15	2.2	7.5
Fairbanks	Alaska	19	7.6	2.0	4.2	Jefferson City	Missouri	26	12	2.4	5.2
Juneau	Alaska	24	10	0.25	5.2	Helena	Montana	24	11	3.3	6.1
Kodiak	Alaska	24	10	<0.10	4.4	Lincoln	Nebraska	3	10	8.2	9.2
Nome	Alaska	22	12	0.70	5.4	Trenton	New Jersey	27	9.2	3.1	5.5
Point Barrow	Alaska	30	13	6.4	3.7	Santa Fe	New Mexico	24	19	1.5	10
St. Paul Island	Alaska	8	7.7	1.6	4.3	Albany	New York	28	12	2.5	5.7
Phoenix	Arizona	25	28	3.7	12	New York	New York	18	14	5.7	10
Little Rock	Arkansas	25	11	2.1	5.6	Gastonia	North Carolina	26	12	2.3	7.2
Berkeley	California	26	18	2.4	7.2	Bismarck	North Dakota	25	10	2.9	5.6
Los Angeles	California	24	24	4.3	12	Columbus	Ohio	25	39	3.6	11
Denver	Colorado	25	28	3.5	12	Oklahoma City	Oklahoma	26	15	3.3	8.4
Hartford	Connecticut	27	10	1.5	5.8	Ponca City	Oklahoma	24	6.6	0.21	3.4
Washington	D. C.	29	17	4.3	8.9	Portland	Oregon	26	19	1.8	8.1
Jacksonville	Florida	26	20	3.1	8.0	Harrisburg	Pennsylvania	24	16	2.0	6.2
Miami	Florida	28	16	2.3	8.5	San Juan	Puerto Rico	16	8.0	2.1	4.1
Atlanta	Georgia	27	11	1.3	5.9	Providence	Rhode Island	25	11	3.5	7.2
Agana	Guam	29	4.3	<0.10	2.2	Columbia	South Carolina	23	11	2.3	5.8
Honolulu	Hawaii	28	5.8	1.4	3.2	Pierre	South Dakota	21	11	3.4	7.4
Boise	Idaho	26	16	4.1	7.1	Nashville	Tennessee	29	13	0.88	6.7
Springfield	Illinois	29	12	1.4	5.4	Austin	Texas	26	9.0	2.0	5.8
Indianapolis	Indiana	27	9.3	0.96	5.2	El Paso	Texas	25	18	2.1	11
Iowa City	Iowa	26	11	3.0	6.0	Salt Lake City	Utah	26	13	2.9	7.0
Topeka	Kansas	25	10	2.8	5.7	Richmond	Virginia	27	13	2.6	6.0
Frankfort	Kentucky	25	16	2.6	8.0	Seattle	Washington	23	8.6	<0.10	3.3
New Orleans	Louisiana	25	16	2.9	6.6	Madison	Wisconsin	26	14	4.0	7.0
Augusta	Maine	30	8.8	2.3	6.2	Cheyenne	Wyoming	26	16	4.1	8.8
Baltimore	Maryland	27	15	3.2	8.1	Sundance	Wyoming	5	11	5.0	9.4
Lawrence	Massachusetts	25	8.1	2.1	5.4	Network average					6.7

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, DECEMBER 1961

Station location		Concentration ($\mu\mu c$/liter)	Activity ($\mu\mu c/m^2$)	Station location		Concentration ($\mu\mu c$/liter)	Activities ($\mu\mu c/m^2$)
City	State			City	State		
Adak	Alaska	[a] —	—	Lansing	Mich.	3,620	41,000
Anchorage	Alaska	4,520	15,000	Minneapolis	Minn.	2,840	39,000
Attu	Alaska	—	—	Jackson	Miss.	—	—
Cold Bay	Alaska	—	—	Pascagoula	Miss.	<254	<20,000
Fairbanks	Alaska	1,960	28,000	Jefferson City	Mo.	1,570	55,000
Juneau	Alaska	1,480	166,000	Helena	Mont.	4,260	48,000
Kodiak	Alaska	—	—	Lincoln	Nebr.	—	—
Nome	Alaska	—	—	Trenton	N. J.	—	—
Point Barrow	Alaska	—	—	Santa Fe	N. M.	3,100	86,400
St. Paul Island	Alaska	—	—	Albany	N. Y.	2,190	6,800
Phoenix	Ariz.	—	—	New York	N. Y.	—	—
Little Rock	Ark.	440	27,300	Gastonia	N. C.	1,110	180,000
Berkeley	Calif.	386	19,000	Bismarck	N. D.	7,580	62,500
Los Angeles	Calif.	2,160	95,300	Columbus	Ohio	3,310	113,000
Denver	Colo.	3,070	4,600	Oklahoma City	Okla.	4,810	40,300
Hartford	Conn.	2,910	170,000	Ponca City	Okla.	1,700	51,100
Washington	D. C.	1,160	84,000	Portland	Oreg.	2,020	205,000
Jacksonville	Fla.	1,230	14,000	Harrisburg	Pa.	3,430	57,000
Miami	Fla.	—	—	San Juan	P. R.	540	39,000
Atlanta	Ga.	734	110,000	Providence	R. I.	7,050	110,000
Agana	Guam	—	—	Columbia	S. C.	1,090	100,000
Honolulu	Hawaii	1,260	56,000	Pierre	S. D.	1,400	74,000
Boise	Idaho	1,520	37,000	Nashville	Tenn.	2,890	46,000
Springfield	Ill.	—	—	Austin	Tex.	576	16,000
Indianapolis	Ind.	4,450	340,000	El Paso	Tex.	5,060	81,000
Iowa City	Iowa	610	23,000	Salt Lake City	Utah	6,630	200,000
Topeka	Kans.	4,630	20,000	Richmond	Va.	1,440	120,000
Frankfort	Ky.	—	—	Seattle	Wash.	2,230	150,000
New Orleans	La.	725	140,000	Madison	Wis.	1,580	25,900
Augusta	Maine	—	—	Cheyenne	Wyo.	511	9,700
Baltimore	Md.	—	—	Sundance	Wyo.	—	—
Lawrence	Mass.	2,380	37,000				

[a] Dash denotes no sample received.

Table 3.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, JANUARY 1962

Station location		Concentration ($\mu\mu c$/liter)	Activities ($\mu\mu c/m^2$)	Station location		Concentration ($\mu\mu c$/liter)	Activities ($\mu\mu c/m^2$)
City	State			City	State		
Adak	Alaska	[a] —	—	Minneapolis	Minn.	1,730	17,000
Anchorage	Alaska	6,100	27,000	Jackson	Miss.	1,050	200,000
Attu	Alaska	—	—	Pascagoula	Miss.	1,590	26,000
Cold Bay	Alaska	—	—	Jefferson City	Mo.	1,360	49,000
Fairbanks	Alaska	1,920	32,000	Helena	Mont.	707	8,500
Juneau	Alaska	3,200	690,000	Lincoln	Nebr.	—	—
Kodiak	Alaska	—	—	Trenton	N. J.	—	—
Nome	Alaska	—	—	Santa Fe	N. M.	2,430	35,000
Point Barrow	Alaska	—	—	Albany	N. Y.	1,290	65,000
St. Paul Island	Alaska	—	—	New York	N. Y.	—	—
Phoenix	Ariz.	—	—	Gastonia	N. C.	1,470	220,000
Little Rock	Ark.	1,370	300,000	Bismarck	N. D.	1,010	8,300
Berkeley	Calif.	1,530	66,000	Columbus	Ohio	2,160	140,000
Los Angeles	Calif.	1,150	84,000	Oklahoma City	Okla.	189	1,800
Denver	Colo.	595	2,200	Ponca City	Okla.	2,460	18,000
Hartford	Conn.	2,610	160,000	Portland	Oreg.	1,290	42,000
Washington	D. C.	811	30,000	Harrisburg	Pa.	3,780	31,000
Jacksonville	Fla.	1,240	56,000	San Juan	P. R.	1,290	29,000
Atlanta	Ga.	1,300	150,000	Providence	R. I.	1,640	170,000
Honolulu	Hawaii	1,230	19,000	Columbia	S. C.	1,640	280,000
Boise	Idaho	7,060	160,000	Pierre	S. D.	2,310	24,000
Springfield	Ill.	90	5,400	Nashville	Tenn.	331	35,000
Indianapolis	Ind.	2,680	290,000	Austin	Tex.	1,740	32,000
Iowa City	Iowa	901	33,000	El Paso	Tex.	1,380	37,000
Topeka	Kans.	1,310	33,000	Salt Lake City	Utah	2,380	36,000
Frankfort	Ky.	842	3,400	Richmond	Va.	770	110,000
New Orleans	La.	1,990	180,000	Seattle	Wash.	1,110	50,000
Augusta	Maine	1,540	100,000	Madison	Wis.	1,150	34,000
Baltimore	Md.	—	—	Cheyenne	Wyo.	170	2,100
Lawrence	Mass.	2,610	124,000	Sundance	Wyo.	—	—
Lansing	Mich.	2,670	130,000	Agana	Guam	—	—

[a] Dash denotes no sample received.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air at Cincinnati, Ohio. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon-222 concentrations are determined from alpha measurements made immediately

after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period January 2–January 26, 1962 appear in table 1.

REFERENCE

Setter, L. R. and G. I. Coats, "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22,* No. 1, Feb. 1961.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, JANUARY 2–26, 1962

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m.[a] ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
	Sample change time	Sample period (hours)	Volume (m^3)				
January 2	0815	94.4	113.8	190	220	0.7	4.34
3	0815	24.0	30.3	220	170	0.8	3.87
4	0800	23.7	29.4	120	130	1.1	11.36
5	0800	23.9	29.5	200	110	2.3	11.59
8	0800	71.9	89.8	110	100	0.7	10.46
9	0810	24.1	30.2	150	140	0.4	5.16
10	0800	23.8	30.4	160	140	0.4	5.95
11	0818	24.2	30.9	280	140	0.7	3.68
12	0810	23.8	29.9	310	110	0.9	4.63
15	0807	71.9	88.3	100	140	0.9	11.31
16	0809	24.0	29.9	110	60	0.4	6.99
17	0801	23.8	30.0	120	130	0.4	8.22
18	0801	23.9	30.1	150	140	0.4	9.49
19	0805	24.0	30.2	130	130	0.7	10.92
22	0801	71.9	88.3	80	190	0.6	10.24
23	0805	24.0	29.8	110	120	0.4	4.26
24	0800	23.9	29.5	180	140	1.1	8.03
25	0805	24.0	29.7	160	170	0.7	7.64
26	0807	24.0	29.6	300	30	1.8	5.25
Average				154	143	0.7	7.87
Range of counting errors (2σ)							
Maximum				30	25	0.5	0.21
Minimum				16	10	0.2	0.06

[a] Sample period and volume does not apply to this column.

Radioactivity Measurements in Surface Air Near the 80th Meridian (West)

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 1. This program is operated by the U.S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile which have made the actual sample collections and forwarded them to NRL for analysis.

Partial financial support of this program is provided by the Division of Biology and Medicine, U.S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously at a rate of approximately 1200 cubic meters per day through high efficiency filters 8-inches in diameter, using positive displacement blowers. Due to the decrease of radioactivity levels during 1960 and 1961, it became necessary to change the sampling period from a daily to a weekly basis at most stations. After the sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

The daily record of fission product beta activity during December 1961 is presented in table 1, and the radioactivity profile along the 80th Meridian (West) for the same month is shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air.

Radiochemical analyses are performed on monthly composite air-filter samples for the following nuclides: strontium-89, strontium-90, yttrium-91, cesium-137, cerium-141, cerium-144, promethium-147, tungsten-185, and lead-210. The 1960 analyses were reported in the March 1962 *Radiological Health Data*. The 1961 analyses will be reported in a future issue.

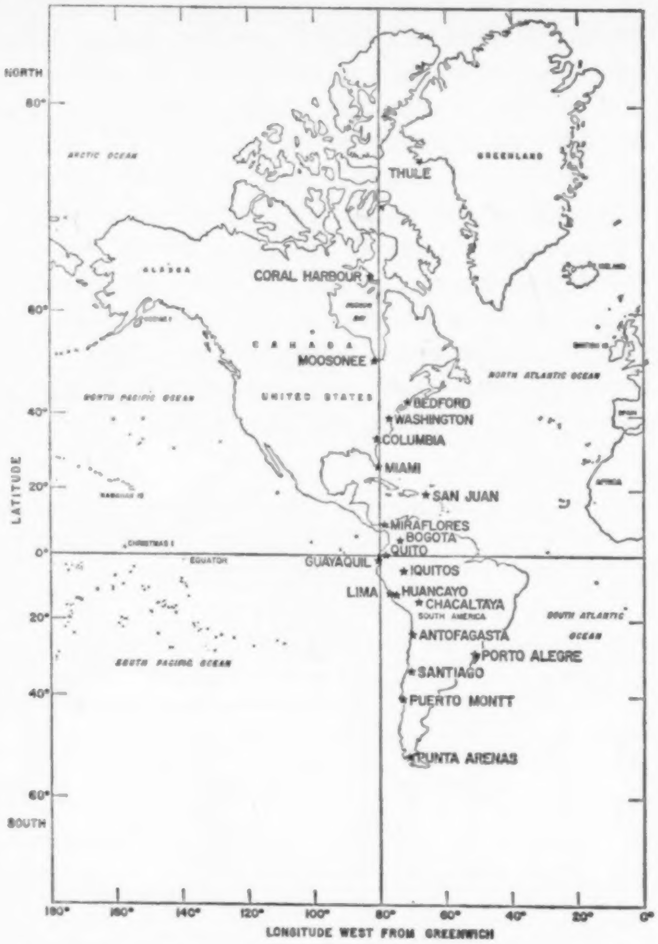

FIGURE 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

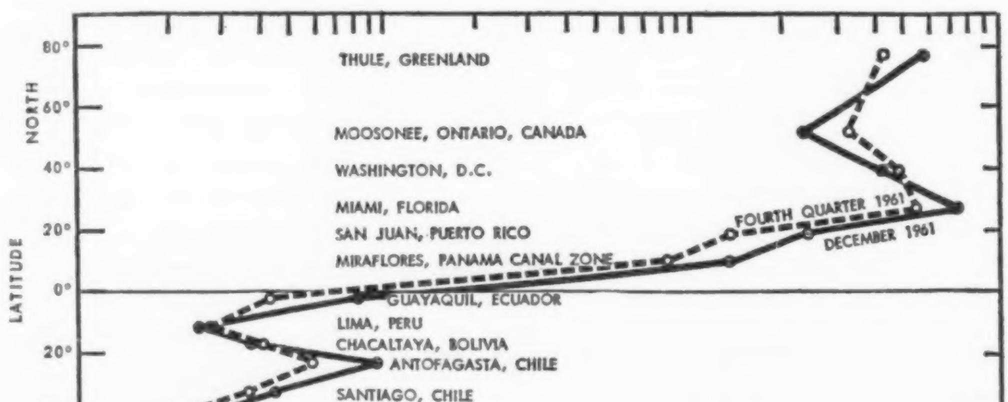

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST) FOURTH QUARTER AND DECEMBER 1961

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NRL, DECEMBER 1962[a]

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	San Juan, P. R.	Mauna Loa, Hawaii	Miami Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	----------	0.045	----------	0.187	0.151	0.061	0.110	0.66	3.50	10.9	20.6	11.1	4.23	14.5
2	----------	0.045	----------	0.187	0.151	0.061	0.110	0.60	3.50	10.9	20.6	11.1	4.23	14.5
3	----------	0.045	----------	0.187	0.151	0.061	0.110	0.60	3.50	10.9	20.6	11.1	5.08	14.5
4	----------	0.045	----------	0.187	0.151	0.061	0.110	0.60	3.50	10.9	20.6	11.1	5.08	14.5
5	0.027	0.058	----------	0.135	0.152	0.026	0.110	2.01	6.03	5.86	15.4	12.0	4.92	14.5
6	0.027	0.058	----------	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	5.04	10.9
7	0.027	0.058	----------	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	4.60	10.9
8	0.027	0.058	----------	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	4.74	10.9
9	0.027	0.058	----------	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	4.16	10.9
10	0.027	0.058	----------	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	3.36	10.9
11	0.027	0.058	----------	0.135	0.152	0.026	----------	2.01	6.03	5.86	15.4	12.0	3.75	10.9
12	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.54	10.9
13	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.79	13.8
14	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.77	13.8
15	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	4.42	13.8
16	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	4.55	13.8
17	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.40	13.8
18	----------	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	4.60	13.8
19	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	6.72	13.8
20	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	7.06	13.1
21	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	5.36	13.1
22	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	10.6	13.1
23	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	5.93	13.1
24	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	6.21	13.1
25	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	9.38	13.1
26	0.037	0.050	0.086	0.275	0.088	0.065	0.295	4.65	2.76	12.5	21.6	9.20	11.2	13.1
27	0.037	----------	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	9.06	----------
28	0.037	----------	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	2.18	----------
29	0.037	----------	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	3.11	----------
30	0.037	----------	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	3.08	----------
31	0.037	----------	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	4.35	----------
Mean (dpm/m³)	0.027	0.057	0.101	0.204	0.083	0.058	0.177	3.17	5.40	8.35	16.4	9.31	5.21	13.0
Mean ($\mu\mu c/m^3$)	0.012	0.026	0.045	0.092	0.037	0.026	0.080	1.43	2.43	3.76	7.39	4.19	2.35	5.86

[a] Continuous weekly samples were collected at all stations except Moosonee, Canada which collected continuous daily samples.
[b] Mauna Loa data has been included for comparison with Chacaltaya, Bolivia. Both are high elevation stations (3400 and 5200 meters) and about equally distant north and south of the equator.

National Air Sampling Network

Division of Air Pollution, Public Health Service

The Public Health Service developed its National Air Sampling Network in 1953 to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, cimate, and other factors associated with air quality.

The current basic network consists of 103 sampling stations operating every year in 66 large cities and 37 nonurban areas. In addition to these every-year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Network Stations appeared in the May 1960 issue of *Radiological Health Data.*

The network stations are manned by cooperating Federal, State, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2000 cubic meters of air are collected on glass fiber filters on a bi-weekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NASN, FOURTH QUARTER 1961

[Concentrations in $\mu\mu c/m^3$]

Station location	Number of samples	Minimum	Maximum	Average
Acadia Nat. Pk., Maine[1]	6	2.1	32.5	15.4
Akron, Ohio	6	8.3	30.8	15.7
Albany, N. Y.	5	1.5	28.2	14.5
Albuquerque, N. Mex.	6	6.2	25.0	14.7
Allentown, Pa.	6	3.4	21.8	14.7
Anchorage, Alaska	5	4.3	27.7	11.1
Atlanta, Ga.	6	6.4	12.3	8.2
Atlantic City, N. J.	7	6.1	28.1	15.0
Augusta, Ga.	6	4.3	48.8	14.9
Austin, Tex.	7	5.6	36.1	24.1
Baltimore, Md.	6	4.5	17.6	12.4
Beaumont, Tex.	6	4.8	15.8	12.7
Berkeley, Calif.	7	1.4	28.6	13.2
Bethlehem, Pa.	7	2.2	25.7	10.8
Binghamton, N. Y.	7	0.6	41.2	12.9
Birmingham, Ala.	6	5.1	58.3	25.2
Bismarck, N. D.	6	6.3	25.2	15.8
Boise, Idaho	6	1.7	13.5	8.3
Boston, Msss.	6	4.6	19.6	10.5
Brockton, Mass.	6	1.0	10.3	4.6
Burlington, Vt.	6	3.4	10.3	6.9
Butte County, Idaho[1]	5	1.3	35.2	20.9
Calvert County, Md[1]	7	1.0	33.7	14.8
Cambridge, Mass.	5	1.8	12.2	7.3
Canton, Ohio	6	1.6	28.8	12.4
Cape Hatteras, N. C.[1]	5	5.3	28.1	13.7
Cape Vincent, N. Y.[1]	6	3.0	18.3	9.7
Charleston, S. C.	6	6.2	32.0	18.0
Charleston, W. Va.	6	8.2	16.3	10.9
Charlotte, N. C.	6	5.3	39.0	14.6
Chattanooga, Tenn.	6	6.5	17.4	12.4
Cherokee County, Okla.[1]	6	2.9	31.5	17.7
Cheyenne, Wyo.	5	8.4	40.6	20.2
Chicago, Ill.	7	6.2	27.4	15.3
Cincinnati, Ohio	6	6.0	25.1	13.0
Clallam County, Wash.[1]	5	1.3	13.1	7.8
Clarion County, Pa.[1]	5	7.3	16.2	13.5
Clayton County, Iowa[1]	7	3.4	20.1	10.9
Cleveland, Ohio	5	1.5	40.6	16.1
Colfax County, N. Mex.[1]	5	3.7	41.0	21.1
Columbia, S. C.	6	7.3	22.3	15.4
Columbus, Ohio	6	3.3	24.0	12.5
Coos County, N. H.[1]	5	3.0	17.6	10.2
Curry County, Oreg.[1]	4	1.8	16.6	9.4
Dallas, Tex.	5	6.3	44.1	15.9
Davenport, Iowa	6	4.9	16.6	10.2
Dayton, Ohio	6	3.6	15.8	9.5
Dearborn, Mich.	5	0.6	34.4	18.7
Denver, Colo.	7	3.2	26.4	14.8
Des Moines, Iowa	6	3.9	14.7	9.1
Detroit, Mich.	6	7.4	21.3	12.2
Door County, Wis.[1]	4	2.4	26.4	9.6
Duluth, Minn.	6	5.9	31.7	13.2
East Chicago, Ind.	7	7.4	15.4	10.0
East St. Louis, Ill.	4	2.1	29.7	13.1
Elmira, N. Y.	7	3.5	16.5	10.2
Erie, Pa.	4	1.0	23.3	14.5
Eugene, Oreg.	6	0.7	59.6	18.5
Flint, Mich.	6	2.6	30.9	14.6
Florida Keys, Fla.[1]	6	1.4	16.2	8.6
Galveston, Tex.	6	4.0	20.0	12.2
Glacier Nat. Pk., Mont.[1]	6	3.8	20.2	13.4
Glen Cove, N. Y.	6	2.7	81.0	32.3
Glendale, Calif.	6	5.7	73.7	24.7
Grand Canyon Pk., Ariz.[1]	6	3.2	41.0	20.6
Greensboro, N. C.	7	5.1	31.8	17.3
Hamilton, Ohio	6	3.7	48.9	19.9
Hammond, Ind.	6	3.9	14.9	10.9
Hampton, Va.	7	1.0	28.9	11.4
Hartford, Conn.	6	5.1	14.6	10.3
Helena, Mont.	7	2.7	52.5	21.0
Honolulu, Hawaii	6	1.6	11.7	5.7
Houston, Tex.	5	6.0	27.3	16.4
Humboldt County, Calif.[1]	5	1.8	25.4	8.5
Indianapolis, Ind.	6	4.8	15.6	8.8
Jackson County, Miss.[1]	6	6.4	35.7	18.1
Jackson, Mich.	7	2.4	22.2	12.2
Jackson, Miss.	4	4.7	35.1	21.2
Jersey City, N. J.	6	1.8	24.5	11.7
Johnstown, Pa.	5	6.8	9.7	8.5
Kahaluu, Hawaii[1]	6	2.3	26.9	10.0
Kansas City, Mo.	6	2.9	26.0	14.5
Kent County, Del.[1]	6	0.8	23.6	12.4
Knoxville, Tenn.	6	2.6	17.9	10.3
Las Vegas, Nev.	5	2.9	52.8	24.8
Little Rock, Ark.	7	4.4	32.8	15.9
Long Beach, Calif.	7	9.8	30.2	22.3
LoQuillo Mtns, P. R.[1]	6	0.1	16.4	4.4
Los Angeles, Calif.	7	0.1	33.0	21.7
Louisville, Ky.	4	2.5	37.4	15.5
Lowell, Mass.	4	3.6	19.7	8.3
Madison, Wis.	7	2.0	39.1	15.1
Manchester, N. H.	5	4.7	21.1	11.0
Maricopa County, Ariz.[1]	6	2.5	108.0	34.3
Massena, N. Y.	6	2.4	9.3	6.5
Medford, Oreg.	5	0.4	10.9	5.0
Memphis, Tenn.	5	2.3	32.8	16.8
Miami, Fla.	6	2.3	62.6	20.9
Milwaukee, Wis.	6	7.0	43.1	17.2
Minneapolis, Minn.	6	2.2	18.9	7.9
Montezuma County, Colo.[1]	5	8.9	33.6	20.4
Montgomery Ala.	6	2.1	37.4	13.0
Montgomery County, Ark.[1]	6	4.1	43.9	16.7
Montgomery County, Ind.[1]	6	3.0	21.3	10.8
Mt. Vernon, N. Y.	7	1.5	45.9	15.8
Nashville, Tenn.	6	3.4	75.6	24.7
New Albany, Ind.	5	2.2	23.0	11.5
New Bedford, Mass.	6	1.6	17.9	11.5
New Britain, Conn.	6	2.8	19.7	10.8
New Haven, Conn.	6	1.8	16.2	7.0
New Orleans, La.	6	1.0	31.7	13.3
New Rochelle, N. Y.	6	2.9	25.3	12.1
New York, N. Y.	7	2.3	31.2	16.8
Newark, N. J.	5	2.9	12.5	7.4
Niagara Falls, N. Y.	2	2.4	13.5	8.0
Norfolk, Va.	5	5.1	15.0	11.8
Oakland, Calif.	7	4.2	26.2	12.6
Oklahoma City, Okla.	5	1.7	38.2	20.3
Omaha, Neb.	6	1.9	21.3	14.1
Orange County, Vt.[1]	6	2.1	19.6	7.8
Orlando, Fla.	5	0.2	18.2	9.3
Pasadena, Calif.	5	2.4	30.5	20.7
Paterson, N. J.	3	5.0	44.5	24.6
Philadelphia, Pa.	6	2.2	13.4	9.2
Phoenix, Ariz.	6	6.1	80.1	31.6
Pittsburgh, Pa.	6	3.4	43.5	14.0
Portland, Maine	6	2.8	11.6	4.9
Portland, Oregon	6	3.0	16.0	8.9
Portsmouth, Va.	6	6.3	37.6	18.9
Providence, R. I.	6	4.0	29.7	15.7
Pt. Woronzof, Alaska[1]	6	2.9	14.6	8.9
Raleigh, N. C.	6	4.6	17.8	12.0
Richland County, S. C[1]	4	1.4	21.7	16.1
Richmond, Va.	6	0.7	17.7	10.3
Roanoke, Va.	7	5.0	60.3	19.1
Rochester, N. Y.	6	2.3	36.9	16.3
Rockford, Ill.	6	3.5	25.0	13.1
Salt Lake City, Utah	7	0.3	28.6	19.8
San Antonio, Tex.	6	1.3	24.8	11.6
San Bernardino, Calif.	6	1.9	58.0	24.1
San Diego, Calif.	6	6.4	20.5	13.2
San Francisco, Calif.	6	2.6	44.0	20.6
San Jose, Calif.	6	6.9	35.1	14.3
San Juan, Puerto Rico	5	1.9	12.6	4.8
Savannah, Ga.	6	7.6	51.2	20.2
Schenectady, N. Y.	6	2.2	18.3	10.0
Scranton, Pa.	6	1.1	30.9	14.1
Seattle, Wash.	6	1.7	13.3	5.9
Shannon County, Mo.[1]	3	5.9	19.0	13.7
Shenandoah Nat. Pk., Va.[1]	6	7.6	63.4	22.5
Shreveport, La.	6	4.8	69.2	23.8
Sioux Falls, S. D.	6	2.5	28.0	15.1
South Bend, Ind.	6	2.7	42.2	16.4
Spokane, Wash.	5	4.8	23.2	13.2
St. Louis, Mo.	6	1.9	21.0	10.2
St. Paul, Minn.	6	2.5	18.6	10.1
St. Petersburg, Fla.	6	2.2	36.8	20.0
Stockton, Calif.	7	2.1	49.1	21.6
Syracuse, N. Y.	6	6.0	15.6	9.6
Tampa, Fla.	7	4.4	30.3	14.7
Terre Haute, Ind.	6	1.2	26.4	9.5
Thomas County, Nebr.[1]	6	9.0	41.8	20.2
Topeka, Kans.	3	0.8	22.3	15.8
Troy, N. Y.	5	2.7	32.1	18.6
Tucson, Ariz.	5	4.1	50.4	21.2
Tulsa, Okla.	6	1.6	35.0	18.1
Utica, N. Y.	6	4.2	14.6	9.1
Ward County, N. D.[1]	7	0.2	29.4	9.2
Washington County, R. I.[1]	5	4.3	17.9	10.1
Washington, D. C.	6	0.2	38.2	16.7
Waterbury, Conn.	4	2.0	18.3	11.1
Wheeling, W. Va.	4	8.3	27.6	15.8
White Pine County, Nev.[1]	6	9.7	53.7	20.7
Wichita, Kans.	7	4.8	14.9	9.9
Wilmington, Del.	5	9.4	29.3	16.1
Worcester, Mass.	6	2.4	24.6	12.5
Yellowstone Pk., Wyo.[1]	6	4.0	27.0	13.7
York, Pa.	6	7.4	19.6	12.3
Youngstown, Ohio	6	3.4	19.5	12.9

[1] Nonurban station.

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NASN, ANNUAL SUMMARY, 1961

[Concentrations in $\mu\mu c/m^3$]

Station location	Number of samples	Minimum	Maximum	Average
Acadia Nat. Pk., Maine[1]	25	<0.1	32.5	4.1
Akron, Ohio	26	<0.1	30.8	3.7
Albany, N. Y	22	<0.1	28.2	4.2
Albuquerque, N. Mex	22	0.1	25.0	4.1
Allentown, Pa	25	<0.1	21.8	4.8
Anchorage, Alaska	25	<0.1	27.7	2.8
Atlanta, Ga	23	<0.1	12.3	2.2
Atlantic City, N. J	26	<0.1	28.1	4.1
Augusta, Ga	26	<0.1	48.8	4.1
Austin, Tex	26	<0.1	36.1	6.6
Baltimore, Md	26	<0.1	17.6	3.1
Beaumont, Tex	25	<0.1	15.8	3.1
Berkeley, Calif	26	<0.1	28.6	4.6
Bethlehem, Pa	25	<0.1	25.7	3.1
Binghamton, N. Y	26	<0.1	41.2	3.6
Birmingham, Ala	26	<0.1	58.3	6.3
Bismarck, N. D	25	<0.1	25.2	4.1
Boise, Idaho	26	<0.1	14.3	2.9
Boston, Mass	24	<0.1	19.6	2.7
Brockton, Mass	26	<0.1	11.0	1.6
Burlington, Vt	24	<0.1	10.3	1.8
Butte County, Idaho[1]	23	<0.1	35.2	4.8
Calvert County, Md.[1]	25	<0.1	33.7	4.2
Cambridge, Mass	24	<0.1	53.0	3.9
Canton, Ohio	26	<0.1	28.8	3.3
Cape Hatteras, N. C.[1]	24	<0.1	31.0	4.6
Cape Vincent, N. Y.[1]	25	<0.1	18.3	2.7
Charleston, S. C	25	<0.1	32.0	6.0
Charleston, W. Va	26	<0.1	16.3	2.8
Charlotte, N. C	26	<0.1	39.0	3.7
Chattanooga, Tenn	26	<0.1	17.4	3.3
Cherokee County, Okla.[1]	25	<0.1	31.5	4.7
Cheyenne, Wyo	25	<0.1	46.2	6.2
Chicago, Ill	26	<0.1	27.4	4.2
Cincinnato, Ohio	25	<0.1	25.1	3.5
Clallam County, Wash.[1]	21	<0.1	13.1	2.0
Clarion County, Pa.[1]	23	<0.1	16.2	3.3
Clayton County, Iowa[1]	24	<0.1	20.1	3.8
Cleveland, Ohio	24	<0.1	40.6	4.7
Colfax County, N. Mex.[1]	21	<0.1	41.0	5.1
Columbia, S. C	24	<0.1	22.3	4.5
Columbus, Ohio	26	<0.1	63.9	5.5
Coos County, N. H.[1]	23	<0.1	22.1	3.8
Dallas, Texas	20	<0.1	44.1	4.1
Davenport, Iowa	23	<0.1	16.6	3.5
Dayton, Ohio	24	<0.1	15.8	2.6
Dearborn, Mich	22	<0.1	34.4	5.6
Denver, Colo	25	<0.1	26.4	4.3
Des Moines, Iowa	24	<0.1	14.7	2.8
Detroit, Mich	26	<0.1	36.1	4.3
Duluth, Minn	25	<0.1	31.7	3.6
East Chicago, Ind	24	<0.1	15.4	3.6
East St. Louis, Ill	23	<0.1	29.7	2.3
Elmira, N. Y	25	<0.1	16.5	2.9
Erie, Pa	22	<0.1	23.3	2.7
Eugene, Oreg	22	<0.1	59.6	5.1
Flint, Mich	20	0.1	30.9	5.1
Florida Keys, Fla.[1]	25	<0.1	16.2	2.4
Galveston, Tex	26	<0.1	20.0	3.2
Glacier Nat. Pk, Mont.[1]	25	<0.1	20.2	3.9
Glen Cove, N. Y	25	<0.1	81.0	8.5
Glendale, Calif	24	<0.1	73.7	6.6
Grand Canyon Pk., Ariz.[1]	25	<0.1	41.0	5.4
Greensboro, N. C	26	<0.1	31.8	4.7
Hamilton, Ohio	26	<0.1	48.9	5.0
Hammond, Ind	26	<0.1	14.9	3.0
Hampton, Va	26	<0.1	28.9	3.2
Hartford, Conn	23	<0.1	14.6	3.0
Helena, Mont	25	<0.1	52.5	6.0
Honolulu, Hawaii	25	<0.1	11.7	1.6
Houston, Tex	24	<0.1	27.3	3.9
Humboldt County, Calif.[1]	23	<0.1	25.4	2.5
Indianapolis, Ind	24	<0.1	15.6	2.3
Jackson County, Miss.[1]	20	<0.1	247.9	17.9
Jackson, Mich	26	<0.1	22.2	3.5
Jackson, Miss	20	<0.1	35.1	4.4
Jersey City, N. J	23	<0.1	24.5	4.0
Johnstown, Pa	22	<0.1	9.7	2.7
Kahaluu, Hawaii[1]	26	<0.1	26.9	2.5
Kansas City, Mo	24	<0.1	26.0	4.1
Kent County, Del.[1]	22	<0.1	23.6	3.8
Knoxville, Tenn	23	<0.1	17.9	3.3
Las Vegas, Nev	23	<0.1	53.0	7.8
Little Rock, Ark	25	<0.1	32.8	4.5
Long Beach, Calif	26	<0.1	30.2	6.2
Loquillo Mtns., P. R.[1]	26	<0.1	16.4	1.1
Los Angeles, Calif	26	<0.1	33.0	6.3
Louisville, Ky	21	<0.1	37.4	3.4
Lowell, Mass	21	<0.1	24.4	3.0
Madison, Wis	26	<0.1	39.1	5.6
Manchester, N. H	21	<0.1	21.1	3.8
Maricopa County, Ariz.[1]	26	<0.1	108.0	8.5
Massena, N. Y	25	<0.1	9.3	1.9
Medford, Oreg	22	<0.1	48.0	3.6
Memphis, Tenn	25	<0.1	32.8	3.7
Miami, Fla	26	<0.1	62.6	5.3
Milwaukee, Wis	23	<0.1	43.1	5.0
Minneapolis, Minn	26	<0.1	18.9	2.5
Montezuma County, Colo.[1]	25	<0.1	33.6	5.6
Montgomery, Ala	26	<0.1	37.4	3.4
Montgomery County, Ark.[1]	24	<0.1	43.9	4.2
Montgomery County, Ind.[1]	25	<0.1	21.3	3.0
Mt. Vernon, N. Y	24	<0.1	45.9	4.7
Nashville, Tenn	25	<0.1	75.6	6.4
New Albany, Ind	20	<0.1	23.0	3.1
New Bedford, Mass	25	<0.1	43.6	4.9
New Britain, Conn	22	<0.1	19.7	3.0
New Haven, Conn	26	<0.1	16.2	2.3
New Orleans, La	26	<0.1	31.7	3.6
New Rochelle, N. Y	23	<0.1	25.3	3.2
New York, N. Y	26	<0.1	31.2	4.6
Newark, N. J	25	<0.1	12.5	1.7
Norfolk, Va	25	<0.1	15.0	2.7
Oakland, Calif	23	<0.1	26.2	4.1
Oklahoma City, Okla	25	<0.1	243.7	14.1
Omaha, Nebr	26	<0.1	21.3	3.5
Orange County, Vt.[1]	25	<0.1	19.6	2.2
Orlando, Fla	21	<0.1	18.2	3.1
Philadelphia, Pa	26	<0.1	13.4	2.4
Phoenix, Ariz	26	<0.1	80.1	8.2
Pittsburgh, Pa	25	0.1	43.5	3.6
Portland, Maine	26	<0.1	11.6	1.2
Portland, Oreg	26	<0.1	16.0	2.4
Portsmouth, Va	24	<0.1	75.0	7.9
Providence, R. I	25	<0.1	29.7	3.9
Pt. Woronzof, Alaska[1]	26	<0.1	14.6	2.2
Raleigh, N. C	24	<0.1	17.8	3.5
Richland County, S. C.[1]	23	<0.1	21.7	3.4
Richmond, Va	24	<0.1	21.8	3.6
Roanoke, Va	26	<0.1	60.3	5.2
Rochester, N. Y	26	<0.1	36.9	3.9
Rockford, Ill	26	<0.1	25.0	3.4
Salt Lake City, Utah	22	<0.1	28.6	7.8
San Antonio, Tex	22	<0.1	227.7	14.2
San Bernardino, Calif	25	<0.1	58.0	6.3
San Diego, Calif	24	<0.1	20.5	3.8
San Francisco, Calif	25	<0.1	44.0	5.1
San Jose, Calif	26	<0.1	35.1	3.9
San Juan, Puerto Rico	24	<0.1	12.6	1.2
Savannah, Ga	26	<0.1	51.2	5.2
Scranton, Pa	26	<0.1	30.9	3.5
Seattle, Wash	25	<0.1	13.3	1.7
Shannon County, Mo.[1]	21	<0.1	19.0	2.4
Shenandoah Nat. Pk., Va.[1]	24	<0.1	63.4	6.4
Shreveport, La	24	<0.1	262.9	17.1
Sioux Falls, S. D	26	<0.1	28.0	4.2
South Bend, Ind	26	<0.1	42.2	4.2
Spokane, Wash	25	<0.1	23.2	3.2
St. Louis, Mo	26	<0.1	21.0	3.0
St. Paul, Minn	26	<0.1	18.6	2.9
St. Petersburg, Fla	25	<0.1	36.8	6.1
Syracuse, N. Y	26	<0.1	15.6	2.5
Tampa, Fla	26	<0.1	30.3	4.0
Terre Haute, Ind	25	<0.1	26.4	2.7
Thomas County, Nebr.[1]	26	<0.1	41.8	5.1
Topeka, Kans	23	<0.1	22.3	2.7
Troy, N. Y	23	<0.1	45.4	6.1
Tucson, Ariz	23	<0.1	50.4	4.7
Tulsa, Okla	22	<0.1	35.0	5.6
Utica, N. Y	24	<0.1	14.6	2.9
Ward County, N. D.[1]	24	<0.1	29.4	3.0
Washington County, R. I.[1]	24	<0.1	17.9	2.4
Washington, D. C	23	<0.1	38.2	4.4
Waterbury, Conn	22	<0.1	44.1	4.1
White Pine County, Nev.[1]	25	<0.1	53.7	5.9
Wichita, Kans	24	<0.1	14.9	3.0
Wilmington, Del	23	<0.1	29.3	3.6
Worcester, Mass	26	<0.1	24.6	3.8
Yellowstone Pk., Wyo.[1]	26	<0.1	27.0	4.2
York, Pa	26	<0.1	46.5	4.9
Youngstown, Ohio	26	<0.1	19.5	3.1

[1] Nonurban station.

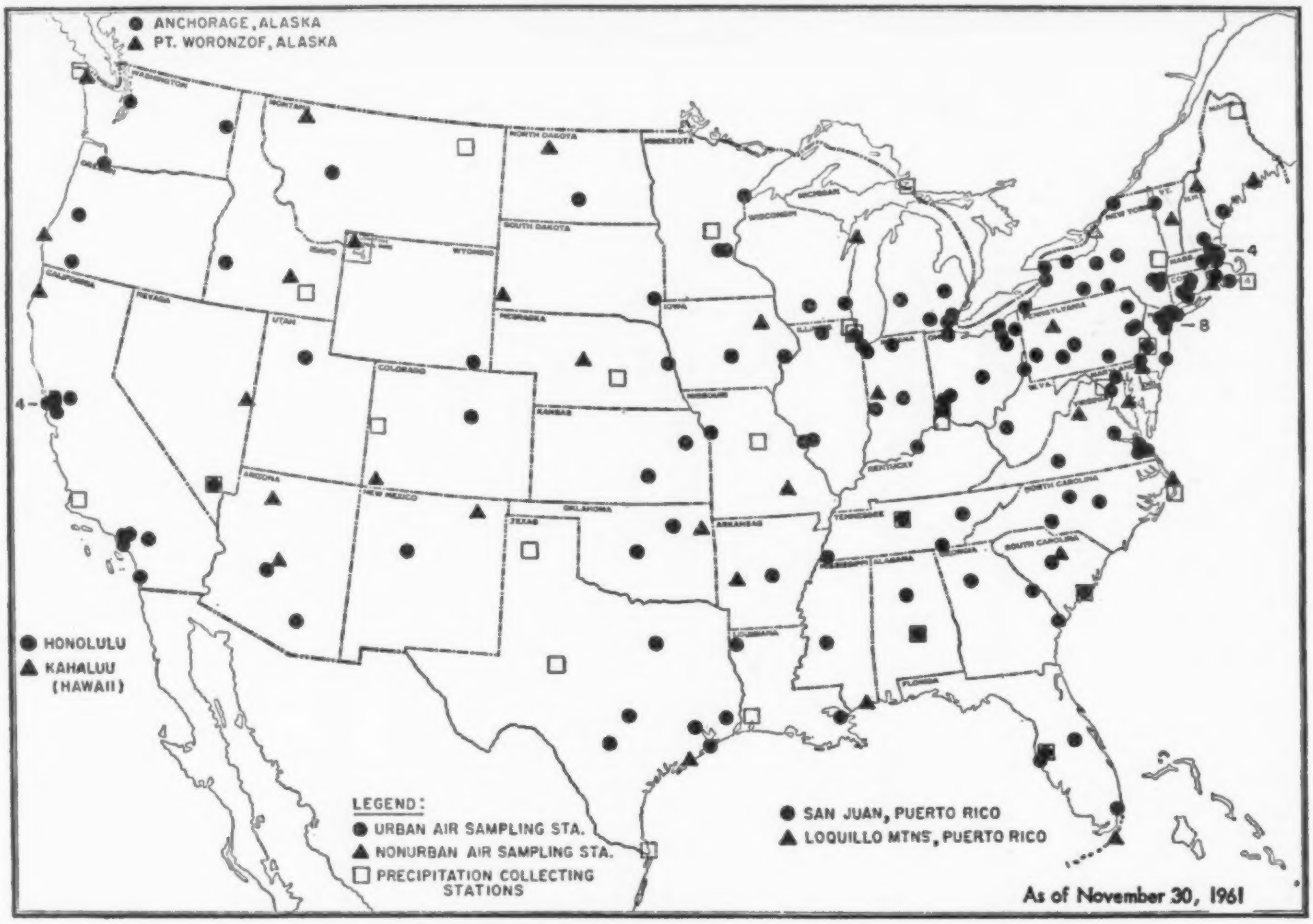

FIGURE 1.—NATIONAL AIR SAMPLING NETWORK SAMPLING STATIONS, 1961

Quarterly reports of individual sample data and annual summaries are distributed to all participating agencies and state health departments.

Gross Beta Activity in Air

Gross beta activity data by states, for the years 1953 through 1958 were submitted by the Chief, Division of Radiological Health, Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearing on Fallout from Nuclear Weapons Tests, Volume I, May 1959, pages 173–185. Subsequent data have been published quarterly in *Radiological Health Data* beginning with the October 1960 issue. The fourth quarter data and the annual summary 1961 are presented in tables 1 and 2.

Due to an increased local interest in fallout following the resumption of nuclear weapons testing by the U.S.S.R., a large number of network stations stepped up their sampling programs. During the period of September through December 1961, 77 stations submitted special samples for radioactivity measurements. Results from these special samples were reported to all network participants on a monthly basis.

Gross Beta Activity in Precipitation

During 1959 a precipitation collection and analysis program was established by the Weather Bureau Research Station in Cincin-

nati, Ohio, and the National Air Sampling Network. The collection stations are located at Weather Bureau offices or airport stations. Monthly composite samples of precipitation are collected at 30 stations (see figure 1) and forwarded to the Network laboratory for analysis. A list of these precipitation collection stations is given below. Samples are analyzed for total solids and a large number of metals and nonmetals. In addition, samples representing 85 percent or more of the total precipitation recorded at the collecting stations are analyzed for fission product gross beta radioactivity if a large enough volume remains after the requirements for the chemical analysis have been met. Data for the Fourth Quarter 1961 appear in table 3. Previous data appeared in Volume I, Nos. 7 and 8; Volume II, Nos. 1, 4, 7, and 10; and Volume III, No. 1.

REFERENCE

Setter, L. R., Zimmer, C. E., Licking, D. S., and Tabor, E. C., "Air-Borne Particulate Beta Radioactivity Measurements of the National Air Sampling Network, 1953–1959," *American Industrial Hygiene Association Journal, 22,* No. 3, June 1961.

PRECIPITATION COLLECTION STATIONS

Alabama: Montgomery
California: Santa Maria
Colorado: Grand Junction
Florida: Tampa
Idaho: Pocatello
Illinois:
  Chicago (Midway Airport)
  Chicago (O'Hare Airport)
Louisiana: Lake Charles
Maine: Caribou
Maryland: Silver Hill
Massachusetts: Nantucket
Michigan: Sault Ste. Marie
Minnesota: St. Cloud
Missouri: Columbia
Montana: Glasgow
Nebraska: Grand Island
Nevada: Las Vegas
New York: Albany
North Carolina: Cape Hatteras
Ohio:
  Cincinnati (research station)
  Cincinnati (airport)
Pennsylvania: Philadelphia
South Carolina:
  Charleston
  Greenville
Tennessee: Nashville
Texas:
  Brownsville
  San Angelo
  Amarillo
Virginia: Sterling
Washington: Tatoosh Island

TABLE 3.—FISSION PRODUCT GROSS BETA ACTIVITY IN PRECIPITATION, NASN, FOURTH QUARTER 1961

Station	October		November		December	
	μμc/liter	μμc/m²	μμc/liter	μμc/m²	μμc/liter	μμc/m²
Albany, N. Y	------	------	1040	91,900	------	------
Chicago, Ill. (Midway)	1040	65,000	------	------	2490	136,000
Chicago, Ill. (O'Hare)	431	34,900	------	------	------	------
Columbia, Mo	578	36,000	406	28,400	------	------
Greenville, S. C	------	------	449	37,000	331	79,700
Lake Charles, La	------	------	66	20,800	------	------
Montgomery, Ala	------	------	509	27,300	281	80,900
Nantucket, Mass	171	18,000	503	28,300	535	34,200
Nashville, Tenn	------	------	732	55,200	481	82,700
Philadelphia, Pa	------	------	------	------	1180	95,000
Sault St. Marie, Mich	------	------	------	------	786	90,700
St. Cloud, Minn	637	33,100	------	------	------	------
Sterling, Va. (Washington, D. C.)	324	22,000	701	42,600	670	42,200
Tampa, Fla	------	------	------	------	225	13,700
Tatoosh Island, Wash	569	100,000	635	142,0 0	727	131,000

SECTION II.—FOOD

Survey of Radioactivity in Food

Food and Drug Administration

The Food and Drug Administration conducts a continuing surveillance to determine the concentrations of certain radionuclides in a variety of different food items, domestic and foreign, as well as animal feeds and other items that may be of importance in the food chain. The data on the animal feeds are presented in the "Other Data" section of this issue. The following tabulations present the results of surveillance of foods for strontium-90. These samples were collected by representatives of the Food and Drug Administration districts.

Prior data from this survey has been presented in the May 1960, and January, August, September, and December 1961 *Radiological Health Data*. In table 1 are assembled additional strontium-90 analyses for 1960 and early 1961. A limited number of items—carrots, spinach, tomatoes, and wheat—are coded with letters in parentheses indicating that several items are from the same lot. By comparing raw and processed items from the same lot, changes in strontium-90 concentrations resulting from the processes of freezing, canning, and milling may generally be noted. Tea continues to show relatively high strontium-90 content in the original leaf form. [*Editor's note: The calculated strontium-90 content of an extract prepared from 2 grams of tea leaves containing the maximum Sr^{90} concentration reported in table 1 (1163 μμc/kg) would be 0.5 μμc/cup or 2 μμc/liter, when a conservative extraction factor of 0.2 is applied.*]

Table 2 presents some results of analyses for strontium-90 content of poultry bones and eggs. These data indicate that strontium-90 concentrations in bones of the older animals are higher than those of the younger animals. Taking the average of the high values (133 μμc/kg) and assuming a calcium content of 20 percent for wet bone, it can be calculated that bone contains 0.67 μμc Sr^{90} per gram of calcium (strontium units). It is interesting to note that the sample of egg shell has a strontium-90 content of the same order as bone.

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS RAW AND PROCESSED FOODS

[Concentrations in $\mu\mu c$/kg original material]

Category	Product	Origin: County	Origin: State or country	Date harvested or processed	Sr^{90}
Vegetables	Lettuce		Wash.		0.72
	Lettuce		Wash.		0.99
	Lettuce	Macomb	Mich.	August 15, 1960	3.5
	Lettuce	Huron	Mich.	August 16, 1960	17
	Lettuce	Huron	Mich.	August 16, 1960	14
	Lettuce	Stark	Ohio	August 17, 1960	4.5
	Lettuce	Denver	Colo.	February 1961	0.3
	Spinach, fresh (a)[1]		Wash.	Spring 1961	5.7
	Spinach, frozen (a)		Wash.	Spring 1961	8.8
	Spinach, fresh (b)		Wash.	Spring 1961	6.0
	Spinach, frozen (b)		Wash.	Spring 1961	9.0
	Spinach, fresh (c)		Wash.	Spring 1961	9.2
	Spinach, frozen (c)		Wash.	Spring 1961	8.9
	Spinach, fresh (d)	Genesee	N. Y.	October 4, 1960	2.9
	Spinach, frozen (d)	Genesee	N. Y.	October 4, 1960	3.6
	Cabbage	Johnson	Kansas	June 19, 1961	6.0
	Cabbage	Weld	Colo.	September 8, 1960	3.7
	Cabbage	Lapeer & St. Clair	Mich.	September 28, 1960	1.6
	Celery	Middlesex	Mass.	September 28, 1960	16
	Celery	Huron	Ohio	August 16, 1960	19
	Celery	Van Buren	Mich.	July, September 1960	3.6
	Celery	Kent	Mich.	August, September 1960	2.8
	Celery	Ottawa	Mich.	July, October 1960	6.3
	Celery	Lapeer	Mich.	September 26, 1960	17
	Celery	Orange	Calif.	January 29, 1961	7.5
	Onions	Huron	Ohio	September 10, 1960	2.1
	Onions	Lorain	Ohio	September 1960	2.0
	Onions	Newaygo	Mich.	September 1960	2.7
	Onions	Mason	Mich.	September 1960	2.6
	Onions	Newaygo	Mich.	September 1960	8.4
	Onions	Marion	Oreg.	September 1960	0.71
	Onions	Grant	Wash.	September 1960	1.1
	Onions	Grant	Wash.	September 1960	1.7
	Onions	Delta	Colo.	September 1960	1.3
	Onions	Monterey	Calif.	September 1960	0.81
	Onions	Bernalillo	N. Mex.	October 1960	1.9
	Onions	Wayne	N. Y.	September 1960	0.71
	Onions	Warren	N. J.	August, September 1960	1.1
	Onions	Warren	N. J.	September 1960	0.05
	Carrots, fresh (e)	Ontario	N. Y.	November 1960	4.7
	Carrots, canned (e)	Ontario	N. Y.	November 1960	2.7
	Carrots, fresh (f)	Genesee	N. Y.	October 1960	8.8
	Carrots, canned (f)	Genesee	N. Y.	October 1960	7.9
	Carrots, fresh (g)	Cass	Mich.	October 1960	2.7
	Carrots, canned (g)	Cass	Mich.	October 1960	1.3
	Carrots, fresh	Dona Ana	N. Mex.	October 1960	1.3
	Carrots, fresh	Costilla	Colo.	September 1960	2.1
	Carrots, fresh	Parmer	Tex.	October 1960	5.1
	Green beans, raw (h)	Mercer	Ohio	September 26, 1960	2.4
	Green beans, canned (h)	Mercer	Ohio	September 26, 1960	0.74
	Green beans, raw (i)	Ashe	N. C.	September 1960	16
	Green beans, canned (i)	Ashe	N. C.	September 1960	13
	Green beans, raw (j)	Hidalgo	Tex.	October 16, 1960	3.9
	Green beans, canned (j)	Hidalgo	Tex.	October 16, 1960	0.83
	Green beans, raw (k)	Wayne	N. Y.	September 22, 1960	36
	Green beans, canned (k)	Wayne	N. Y.	September 22, 1960	23
	Green beans, raw (l)	Santa Cruz	Calif.	September 15, 1960	11
	Green beans, canned (l)	Santa Cruz	Calif.	September 15, 1960	20
	Soybeans	Baltimore	Md.	Late 1960	81
	Soybeans	Peach	Ga.	October, November 1960	145
	Soybeans	Clinton	Ohio	1960	13
	Soybeans	Wayne	N. Y.	1960	24
	Soybeans	Leavenworth	Kans.	1960	31
	Soybeans	Hale	Tex.	November 1960	14
	Peas, dried	Whitman	Wash.	July 1960	5.4
Fruits	Tomatoes, fresh, (m)	Darke	Ohio	1960	1.2
	Tomatoes, canned (m)	Darke	Ohio	1960	0.25
	Tomatoes, fresh (n)	Sandusky	Ohio	September 1, 1960	0.50
	Tomatoes, canned (n)	Sandusky	Ohio	September 1, 1960	2.1
	Tomatoes, canned	Madison	Ind.	September 14, 1960	0.36
	Tomatoes, canned	San Joaquin	Calif.	September 15, 1960	1.6
	Tomatoes, fresh (o)	Davis	Utah	September 7, 1960	0.78
	Tomatoes, canned (o)	Davis	Utah	September 7, 1960	1.3
	Tomatoes, fresh (p)	Wayne	N. Y.	September 23, 1960	2.8
	Tomatoes, canned (p)	Wayne	N. Y.	September 23, 1960	0.21
	Tomatoes, fresh	Henry	Ind.	September 22, 1960	1.3
	Tomatoes, fresh (q)	Adair	Okla.	August 16, 1960	1.74
	Tomatoes, canned (q)	Adair	Okla.	August 16, 1960	2.5
	Tomatoes, fresh (r)	Adair	Okla.	August 16, 1960	0.34
	Tomatoes, canned (r)	Adair	Okla.	August 16, 1960	2.2
	Tomatoes, fresh (s)	Westmoreland	Va.	August 25, 1960	3.4
	Tomatoes, canned (s)	Westmoreland	Va.	August 25, 1960	1.9
	Peaches, peeled pitted	Benzie	Mich.	August 30, 1960	0.51

[1] Code letters in parentheses indicate items from same product lot, i.e., frozen spinach (a) obtained from Washington State fresh spinach (a).

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS RAW AND PROCESSED FOODS—Continued

[Concentrations in $\mu\mu c$/kg original material]

Category	Product	Origin		Date harvested or processed	Sr^{90}
		County	State or country		
Fruits—Continued	Apples, whole	Hood River	Oreg.	October 1960	0.22
	Apples, whole	Chelan	Wash.	October 1960	2.8
	Raisins	Madera	Calif.	August 25, 1960	5.2
	Raisins	Madera	Calif.	August 25, 1960	4.2
	Raisins	Fresno	Calif.	August 15, 1960	8.8
	Strawberries	Santa Cruz	Calif.	November 1, 1960	1.1
	Cranberries	Vilas	Wisc.	Fall 1960	3.6
Nuts	Cashew		Bombay, India	1960	0.79
	Cashew		S. India	1960	3.6
	Cashew		Brazil	1960	4.0
	Brazil		Brazil	1960	18
	Walnuts	Marion	Oreg.	Fall 1960	9.3
	Pecans	Lincoln	Okla.	1960	11
	Pecans	Orangeburg	S. C.	Fall 1960	12
	Pecans	Montgomery	Ala.	November 1960	17
	Almonds	San Joaquin	Calif.	October 15, 1960	19
	Almonds	Contra Costa	Calif.	October 15, 1960	7.8
	Almonds	Stanislaus	Calif.	October 15, 1960	8.9
	Almonds	Colusa	Calif.	Fall 1960	6.6
	Almonds	Colusa	Calif.	Fall 1960	5.9
	Almonds	Colusa	Calif.	Fall 1960	10.9
Coffee beans, cocoa beans and tea	Black tea leaves		Mozambique	January–March 1961	15
	Black tea leaves		Nyasaland	November, December 1960	56
	Black tea leaves		Kenya & Tanganyika	October, November 1960	49
	Black tea leaves		Kenya & Uganda	May, July 1960	19
	Black tea leaves	Sao Paulo	Brazil	August, October 1960	160
	Black tea leaves	Sao Paulo	Brazil	November, December 1960	200
	Black tea leaves	Misiones	Argentina	Early 1960	37
	Black tea leaves	Misiones	Argentina	Late 1960	47
	Black tea leaves		Java	June, July 1960	36
	Black tea leaves		Java	September 1960	71
	Black tea leaves		Java	January, February 1960	83
	Black tea leaves		Sumatra	May, July 1960	40
	Black tea leaves		Formosa	April–October 1960	450
	Black tea leaves		Formosa	August–October 1961	1120
	Green tea leaves		Japan	May–June 1960	180
	Black tea leaves		S. India	May, July 1960	115
	Black tea leaves				89
	Black tea leaves		S. India	December 1960, January 1961	310
	Black tea leaves		N. India	June 1960	240
	Black tea leaves		N. India	November, December 1960	1163
	Black tea leaves		Ceylon	July, August 1960	315
	Black tea leaves		Ceylon	September, October 1960	110
	Green coffee beans		Mexico	1960	33
	Green coffee beans		Madagascar	1960	31
	Coffee		Uganda	1960	9.5
	Cocoa beans		Samoa	1960	8.2
	Cocoa beans		Ivory Coast	1960	15
	Cocoa beans		Brazil	1960	8.8
Wheat and derivatives	Wheat	Baltimore	Md.	1960	59
	Wheat	Accomack	Va.	1961	53
	Wheat	Johnson	Kans.	July, August 1961	11
	Wheat	Phillips & Sedgwick	Colo.	July 1960	28
	Wheat (t)	Canyon	Idaho	August 1960	3.3
	Bran (t)	Canyon	Idaho	August 1960	9.6
	Flour (t)	Canyon	Idaho	August 1960	0.81
	Wheat (u)	Kimball	Nebr.	July 15, 1960	10
	Bran (u)	Kimball	Nebr.	July 15, 1960	49
	Flour (u)	Kimball	Nebr.	July 15, 1960	3.8
	Bran	Texas	Mo. Wyo. & Mont.	July 1, 1960	29
	Bran			1960	18
	Bran	Onondaga & Oneida	N. Y.	1960	73
	Flour	Cache	Utah	July 15, 1960	0.88
	Flour	Solano	Calif.	September 13, 1960	0.77
	Flour		Mo. & Ill.	July 1, 1960	2.4
	Flour	Yates	N. Y.	August 15, 1960	3.1
Dairy products	Milk, evaporated	Neosho & Wilson	Kans.	December 19, 1960	4.6
	Milk, evaporated	Cache	Utah	December 1960	10
	Milk, evaporated	Grant	Ind.	December 29, 1960	14
	Milk, evaporated	Defiance	Ohio	December 24, 1960	2.1
	Cheese, cheddar	Marion & Clackamas	Oreg.	February 4, 1961	13
	Cheese, cheddar	Marion & Clackamas	Oreg.	January 19, 1961	28
	Cheese, cheddar	Wayne	Utah	October 26, 1960	32
	Cheese, cheddar	Wayne	Utah	August 28, 1960	17
	Cheese, cheddar		N. Y.	December 28, 1960	35
	Cheese, cheddar	Scott, Carver, Sibley, Mcleod	Minn.	September 15, 1960	29

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS RAW AND PROCESSED FOODS—Continued

[Concentrations in $\mu\mu c$/kg original material]

Category	Product	Origin: County	Origin: State or country	Date harvested or processed	Sr^{90}
Seafoods	Oysters	Gulf of Mexico		November 7, 1960	1.2
	Oysters	York River	Va.	January 1961	9.8
	Lobster, Rock		Australia	1960	1.3
	Clams	Core Sound	N. C.	December 1960	77
Baby foods	Spinach, creamed, strained		N. Y.	Spring 1961	5.3
	Green Beans, strained		N. C.	July 10, 1961	25
	Peas, strained		Mich.	July 13, 1960	4.1
	Sweet Potatoes, strained		N. C.	January 9, 1961	6.2
	Carrots, strained		Mich.	September 29, 1960	1.6
	Squash, strained		N. Y.	October 9, 1960	5.4
	Apricots, strained w/tapioca		Calif.	June 20, 1960	1.3
	Plums, strained w/tapioca		Mich.	1960	0.71
	Pears, Junior		Mich.	1960	2.0
	Applesauce, strained		N. C.	November 5, 1960	0.75
	Applesauce, strained		Calif.	September 1960	0.13
	Chicken broth				1.4
	Veal, strained				0.51
	Veal, strained			May 16, 1960	1.2
	Wheat flour				4.2
	Wheat gluten		Ohio		6.1
	Wheat germ		N. Y.		44
	Wheat germ		Minn.		23
	Corn flour		Ind.		0.10
	Corn flour		Ill.		5.3
	Oat flour		Iowa		5.0
	Oat flour		Mo.		5.6
	Oat flour		Iowa		5.7
	Soy flour		Ill.		27
	Rice flour		Calif.		0.90

TABLE 2.—STRONTIUM-90 CONTENT OF POULTRY BONES AND EGGS

[Concentrations in $\mu\mu c$/kg original material]

Category	Product	Origin: County or city	Origin: State or county	Date harvested or processed	Sr^{90}
Bones (not dried)	Fowl, 6 mo–2 yr		Maine	1961	120
	Turkey, "old"		Md.	1961	130
	Fowl, 6 mo–2 yr		N. Y.	1961	120
	Fowl, 6 mo–2 yr		Va.	1961	190
	Fowl, age?		Tex.	1961	110
	Turkey, 16–20 wks		Utah	1961	130
	Turkey, 16–20 wks		Ind.	1961	43
	Fryer, 8–12 wks		Calif.	1961	11
	Fryer, 8–12 wks		Conn.	1961	41
	Fryer, age?		N. C.	1961	17
	Turkey, 16–20 wks		Calif.	1961	37
	Turkey, 16–20 wks		Calif.	1961	31
Eggs	Eggs	Kalamazoo	Mich.	August 1960	3.0
	Eggs		Calif.	September 1960	1.2
	Egg shell	Buchanan	Mo.	November 1960	160

SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data (RHD)* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During November 1961, the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During the second week in September, when increased levels of gross beta radioactivity in air were reported by the Radiation Surveil-

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, NOVEMBER 1961

lance Network, the frequency of milk sampling was accelerated at selected stations. Daily sampling of pasteurized milk, with analyses for iodine-131 content, was initiated on September 19, 1961, at six selected stations.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum levels of detection for strontium-89, strontium-90, iodine-131, cesium-137, and barium-140 in terms of $\mu\mu c$/liter are 5, 1, 10, 5, and 10, respectively.

A comparison was made of cesium-137 concentrations in milk to show that they remained quite constant throughout the month. A number of milk samples collected during November from locations with high (90 $\mu\mu c$/liter), medium (20 $\mu\mu c$/liter), and low (<5 $\mu\mu c$/liter) concentrations were analyzed. The data indicate that cesium-137 levels remain quite constant throughout the month. Therefore, many sampling locations will have only one analysis performed each month for cesium-137.

Table 1 presents a summary of all available analyses. The numbers in parentheses indicate the number of samples involved in each average, and are a guide to the reliability of the average for the month. When a radionuclide was not detectable, one half of the minimum level of detection was used for averaging.

The sampling schedule in effect during the month of November was as follows:

(a) Daily sampling at:

Chicago, Ill.	New York, N. Y.
New Orleans, La.	Austin, Tex.
St. Louis, Mo.	Seattle, Wash.

(b) Three samples per week at:

Palmer, Alaska	Jackson, Miss.
Sacramento, Calif.	Pascagoula, Miss.
Denver, Colo.	Omaha, Nebr.
Washington, D. C.	Charleston, S. C.
Tampa, Fla.	Salt Lake City, Utah
Atlanta, Ga.	Milwaukee, Wis.
Wichita, Kans.	

(c) Two samples per week at remainder of the stations.

TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, NOVEMBER 1961

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (grams/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average
Montgomery	Ala.	[a] NA	[b] 1.27 (1)	NA	<5 (1)	NA	6 (1)	NA	30 (1)	NA	<5 (1)	NA	30 (1)
Palmer	Alaska	1.12	1.14 (4)	[c] —	50 (4)	7	10 (4)	—	40 (13)	10	15 (10)	—	10 (10)
Phoenix	Ariz.	1.04	1.10 (2)	—	10 (2)	4	13 (2)	—	80 (9)	<5	5 (8)	—	10 (8)
Little Rock	Ark.	1.21	1.22 (4)	—	85 (4)	16	13 (4)	—	150 (7)	10	15 (1)	—	30 (4)
Sacramento	Calif.	1.10	1.16 (7)	<5	15 (7)	5	4 (7)	<10	30 (21)	10	10 (10)	<10	<10 (13)
San Francisco	Calif.	1.06	1.04 (1)	—	5 (1)	4	2 (1)	—	20 (8)	10	5 (6)	—	<10 (6)
Denver	Colo.	1.05	1.15 (4)	<5	25 (4)	5	5 (4)	20	40 (8)	10	10 (6)	<10	<10 (6)
Hartford	Conn.	1.15	1.16 (4)	—	40 (4)	8	8 (4)	—	30 (8)	15	10 (1)	—	20 (4)
Wilmington	Del.	1.18	1.14 (4)	—	85 (4)	10	8 (4)	—	60 (8)	15	15 (1)	—	40 (4)
Washington	D. C.	1.14	1.18 (4)	5	50 (4)	7	10 (4)	20	30 (14)	10	10 (1)	<10	20 (4)
Tampa	Fla.	1.24	1.23 (4)	<5	30 (4)	5	6 (4)	20	40 (11)	85	90 (1)	<10	10 (4)
Atlanta	Ga.	1.23	1.20 (4)	<5	15 (4)	10	10 (4)	30	40 (13)	15	10 (1)	<10	10 (4)
Honolulu	Hawaii	1.06	1.11 (1)	—	10 (1)	6	2 (1)	—	20 (7)	10	10 (5)	—	<10 (5)
Idaho Falls	Idaho	1.05	1.01 (1)	—	35 (1)	6	4 (1)	—	100 (7)	5	10 (5)	—	10 (5)
Chicago	Ill.	1.14	1.18 (4)	10	90 (4)	5	6 (4)	40	70 (21)	15	15 (1)	<10	40 (4)
Indianapolis	Ind.	1.18	1.21 (4)	—	65 (4)	6	9 (4)	—	60 (6)	10	<5 (1)	—	40 (4)
Des Moines	Iowa	1.04	1.06 (1)	—	80 (1)	7	11 (1)	—	210 (8)	10	10 (6)	—	20 (6)
Wichita	Kans.	1.08	1.10 (5)	—	45 (5)	11	8 (5)	—	140 (16)	5	10 (7)	—	10 (7)
Louisville	Ky.	1.15	1.19 (4)	—	70 (4)	9	9 (4)	—	80 (8)	5	5 (1)	—	40 (4)
New Orleans	La.	1.28	1.24 (4)	5	85 (4)	13	14 (4)	30	60 (18)	25	20 (1)	<10	40 (4)
Portland	Maine	1.19	1.21 (4)	10	60 (4)	9	12 (4)	10	30 (8)	30	35 (1)	<10	40 (4)
Baltimore	Md.	1.16	1.16 (4)	—	40 (4)	10	7 (4)	—	30 (9)	15	<5 (1)	—	30 (4)
Boston	Mass.	1.17	1.18 (4)	—	90 (4)	10	10 (4)	—	40 (8)	30	<5 (1)	—	40 (4)
Detroit	Mich.	1.14	1.18 (4)	—	65 (4)	6	7 (4)	—	90 (6)	5	15 (1)	—	30 (4)
Grand Rapids	Mich.	1.18	1.17 (4)	—	90 (4)	7	6 (4)	—	60 (7)	5	<5 (1)	—	40 (4)
Minneapolis	Minn.	1.07	1.11 (1)	—	140 (1)	9	10 (1)	—	150 (9)	15	15 (7)	—	10 (7)
Jackson	Miss.	1.26	1.26 (4)	5	70 (4)	12	14 (4)	50	60 (12)	15	5 (1)	<10	40 (4)
Pascagoula	Miss.	NA	1.26 (4)	NA	70 (4)	NA	15 (4)	70	50 (7)	NA	20 (1)	NA	30 (4)
Kansas City	Mo.	1.04	1.04 (1)	—	75 (1)	9	11 (1)	—	190 (7)	5	15 (3)	—	20 (3)
St. Louis	Mo.	1.07	1.16 (5)	10	50 (5)	8	10 (5)	60	100 (26)	10	10 (10)	<10	10 (10)
Helena	Mont.	1.05	1.06 (1)	—	25 (1)	7	4 (1)	—	110 (10)	15	20 (8)	—	10 (8)
Omaha	Nebr.	1.13	1.16 (5)	—	100 (5)	8	9 (5)	—	120 (15)	10	10 (9)	—	10 (9)
Manchester	N. H.	1.19	1.18 (4)	—	65 (4)	9	11 (4)	—	40 (8)	40	30 (1)	—	40 (4)
Trenton	N. J.	1.14	1.17 (4)	—	45 (4)	8	10 (4)	—	30 (6)	10	5 (1)	—	20 (4)
Albuquerque	N. Mex.	1.09	1.16 (1)	—	5 (1)	3	3 (1)	—	40 (9)	5	10 (6)	—	10 (6)
Buffalo	N. Y.	1.13	1.12 (4)	—	60 (4)	7	6 (4)	—	20 (6)	10	<5 (1)	—	30 (4)
New York	N. Y.	1.13	1.13 (4)	5	60 (4)	9	8 (4)	50	40 (22)	15	15 (1)	10	40 (4)
Syracuse	N. Y.	1.15	1.18 (4)	—	55 (4)	6	8 (4)	—	30 (8)	10	15 (1)	—	30 (4)
Charlotte	N. C.	1.22	1.25 (4)	—	20 (4)	12	11 (4)	—	20 (8)	10	<5 (1)	—	20 (4)
Minot	N. D.	1.04	1.14 (1)	5	5 (1)	7	9 (1)	20	20 (6)	10	10 (4)	<10	10 (4)
Cincinnati	Ohio	1.20	1.22 (4)	—	80 (4)	9	9 (4)	—	80 (5)	<5	<5 (1)	—	4 (4)
Cleveland	Ohio	1.17	1.18 (4)	—	55 (4)	7	7 (4)	—	50 (7)	5	10 (1)	—	30 (4)
Oklahoma City	Okla.	1.19	1.21 (4)	—	80 (4)	6	8 (4)	—	160 (9)	5	<5 (1)	—	30 (4)
Portland	Oreg.	1.10	1.02 (1)	—	180 (1)	11	33 (1)	—	170 (7)	20	30 (5)	—	40 (5)
Philadelphia	Pa.	1.18	1.18 (4)	—	50 (4)	8	8 (4)	—	40 (8)	15	5 (1)	—	30 (4)
Pittsburgh	Pa.	1.15	1.15 (4)	—	50 (4)	11	10 (4)	—	30 (8)	10	10 (1)	—	30 (4)
San Juan	P. R.	1.17	1.14 (4)	—	25 (4)	4	5 (4)	—	20 (8)	10	<5 (1)	—	20 (4)
Providence	R. I.	1.15	1.18 (4)	—	90 (4)	12	8 (4)	—	50 (8)	30	10 (1)	—	40 (4)
Charleston	S. C.	1.22	1.19 (4)	<5	15 (4)	11	11 (4)	30	20 (11)	30	30 (1)	<10	30 (4)
Chattanooga	Tenn.	1.28	1.27 (4)	—	45 (4)	12	9 (4)	—	40 (8)	15	<5 (1)	—	30 (4)
Memphis	Tenn.	1.23	1.23 (4)	—	65 (4)	12	14 (4)	—	80 (9)	5	10 (1)	—	30 (4)
Austin	Tex.	1.20	1.17 (4)	<5	20 (4)	2	4 (4)	10	60 (27)	<5	<5 (1)	<10	30 (4)
Dallas	Tex.	1.17	1.22 (4)	<5	55 (4)	6	10 (4)	10	100 (7)	10	<5 (1)	<10	30 (4)
Salt Lake City	Utah	1.16	1.22 (4)	5	20 (4)	4	4 (4)	50	60 (12)	10	10 (9)	<10	10 (9)
Burlington	Vt.	1.14	1.17 (4)	—	60 (4)	8	11 (4)	—	50 (8)	15	<5 (1)	—	30 (4)
Norfolk	Va.	1.22	1.22 (4)	—	50 (4)	9	11 (4)	—	30 (8)	10	15 (1)	—	30 (4)
Seattle	Wash.	1.06	1.16 (6)	10	80 (6)	11	16 (6)	<10	120 (25)	15	15 (8)	<10	10 (8)
Spokane	Wash.	1.04	NA	—	NA	9	NA	—	60 (9)	20	15 (5)	—	10 (5)
Charleston	W. Va.	1.17	1.17 (4)	—	70 (4)	11	10 (4)	—	20 (8)	10	<5 (1)	—	30 (4)
Milwaukee	Wis.	1.17	1.19 (4)	—	65 (4)	5	7 (4)	—	80 (17)	10	15 (1)	—	30 (4)
Laramie	Wyo.	1.04	1.13 (1)	—	<5 (1)	7	4 (1)	—	30 (8)	15	15 (6)	—	<10 (6)
Network average		1.14	1.16	5	54	8	9	30	65	15	12	<10	20

[a] NA indicates no analysis made. Montgomery, Ala., and Pascagoula, Miss., stations were not operating during third quarter.
[b] Numbers in parentheses indicate total number of analyses reported during the month.
[c] Dash indicates that the average concentration during the third quarter was reported to be less than the minimum level of detection. The minimum levels of detection for Sr^{89}, Sr^{90}, I^{131}, Cs^{137}, and Ba^{140} in terms of $\mu\mu c$ liter are 5, 1, 10, 5, and 10, respectively. (Dashes are not used in calculation of network averages.)

All surveillance data will be subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Comparison of the results of the November averages with the third quarter averages shows that the November stable calcium, strontium-90, and cesium-137 results are generally within anticipated variations. The analyses for strontium-89 show that the concentrations of this nuclide during November generally showed an increase over the October data. The November iodine-131 and barium-140 levels show a decrease from the previous month.

[*Editor's note: Rapid City, South Dakota becomes a reporting station this month; however, it will not be indicated on the figure showing sampling stations until analytical results are available.*]

SECTION IV.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provisions of Section 4 (c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies, and industrial organizations, commenced operations in October 1957. During October 1961, 94 sampling stations submitted water samples for analyses. These stations are located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the U.S.S.R. has resulted in an increase in radioactivity of surface waters. Evidence obtained during October–December 1961 indicates a 5 to 10-fold increase in gross beta radioactivity of the surface waters over the 1960 average in some areas, particularly in North Central, Northeastern, and Eastern United States. The

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in $\mu\mu c$/liter]

Station	Quarter ending Sept. 30, 1961	October 1961					
	Total Sr^{90}	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.3	4	16	20	0	<1	<1
Animas River: Cedar Hill, N. Mex	0.3	11	30	41	1	4	5
Apalachicola River: Chattahoochie, Fla	0.4	2	3	5	[a]—	—	—
Arkansas River:							
Coolidge, Kansas	2.3	91	79	170	6	46	52
Ponca City, Okla	—	38	55	93	2	10	12
Pendleton Ferry, Ark	—	46	17	63	7	1	8
Big Sioux River: Sioux Falls, S. Dak	0.4	29	75	104	1	3	4
Chattahoochie River:							
Atlanta, Ga	—	4	3	7	0	0	0
Columbus, Ga	—	3	5	8	0	0	0
Clear Water River: East Lewiston, Idaho	—	10	22	32	0	0	0
Colorado River:							
Loma, Colo	—	24	46	70	1	4	5
Page, Ariz	—	385	39	424	75	7	82
Boulder City, Nev	1.0	7	28	35	0	6	6
Parker Dam, Calif	—	3	23	26	0	4	4
Yuma, Ariz	—	3	50	53	—	—	—
Columbia River:							
Wenatchee, Wash	—	2	4	6	0	1	1
Pasco, Wash	1.1	79	623	702	0	0	0
Bonneville Dam, Oreg	[b] 0.6	15	305	320	0	1	1
Clatskanie, Oreg	—	16	168	184	—	—	—
McNary Dam, Oreg	1.2	114	168	282	0	1	1
Connecticut River: Northfield, Mass	0.4	5	8	13	0	0	0
Cumberland River: Clarksville, Tenn	0.4	1	5	6	0	0	0
Delaware River:							
Martins Creek, Pa	—	4	4	8	0	0	0
Philadelphia, Pa	—	7	14	21	0	0	0
Escambia River: Century, Fla	[b] 0.9	6	8	14	—	—	—
Great Lakes:							
Buffalo, N. Y	—	3	7	10	0	0	0
Detroit, Mich	[b] 0.6	4	11	15	0	0	0
Port Huron, Mich	0.4	2	6	8	0	2	2
Milwaukee, Wis	—	5	7	12	0	1	1
Sault Ste. Marie, Mich	—	1	4	5	—	—	—
Gary, Ind	0.2	1	7	8	0	1	1
Duluth, Minn	—	3	3	6	—	—	—
Hudson River: Poughkeepsie, N. Y	0.2	2	6	8	0	0	0
Illinois River:							
Peoria, Ill	0.4	5	22	27	—	—	—
Grafton, Ill	—	0	17	17	0	2	2
Kanawha River: Winfield Dam, W. Va	—	6	7	13	—	—	—
Klamath River: Copco, Oreg	—	4	7	11	0	<1	<1
Little Miami River: Cincinnati, Ohio	1.1	6	16	22	<1	1	1
Merrimack River: Lowell, Mass	[b] 0.7	6	17	23	—	—	—
Mississippi River: St. Paul, Minn	0.9	4	26	30	0	0	0
Mississippi River:							
Dubuque, Iowa	—	15	23	38	—	—	—
Burlington, Iowa	0.6	8	20	28	1	1	2
E. St. Louis, Ill	—	12	19	31	<1	1	1
Cape Girardeau, Mo	0.8	52	20	72	7	1	8
West Memphis, Ark	—	21	14	35	0	0	0
Delta, La	[b] 0.4	23	18	41	—	—	—
New Orleans, La	—	13	13	26	0	1	1
Vicksburg, Miss	—	34	17	51	4	1	5
Missouri River:							
Williston, N. Dak	—	34	12	46	8	4	12
Bismarck, N. Dak	—	12	13	25	1	0	1
Yankton, S. Dak	0.6	9	30	39	1	3	4
Omaha, Nebr	—	20	27	47	2	3	5
St. Joseph, Mo	—	34	29	63	3	4	7
Kansas City, Kan	—	34	20	54	5	2	7
St. Louis, Mo	1.4	28	18	46	—	—	—
Monongahela River: Pittsburgh, Pa	0.4	6	16	22	0	<1	<1
North Platte River: Henry, Nebr	—	12	55	67	0	24	24
Ohio River:							
East Liverpool, Ohio	0.4	2	31	33	—	—	—
Huntington, W. Va	—	7	12	19	0	0	0
Cincinnati, Ohio	—	10	3	13	0	0	0
Louisville, Ky	0.4	4	13	17	<1	<1	1
Evansville, Ind	—	13	19	32	0	<1	<1
Cairo, Ill	1.1	—	—	—	—	—	—
Ouachita River: Bastrop, La	—	11	12	23	1	1	2
Potomac River:							
Williamsport, Md	—	3	15	18	0	0	0
Great Falls, Md	—	5	14	19	0	1	1
Platte River: Plattsmouth, Nebr	—	40	42	82	7	3	10
Red River, North: Grand Forks, N. Dak	—	21	28	49	0	3	3
Red River, South:							
Index, Ark	—	23	21	44	7	1	8
Denison, Tex	—	2	34	36	0	0	0
Alexandria, La	1.0	14	13	27	5	2	7
Rio Grande River:							
Alamosa, Colo	[b] 0.4	3	15	18	0	2	2
El Paso, Tex	—	0	0	0	—	—	—
Laredo, Tex	—	18	18	36	3	3	6
Brownsville, Tex	—	9	19	28	—	—	—

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Concentrations in $\mu\mu c$/liter]

Station	Quarter ending Sept. 30, 1961	October 1961					
	Total Sr^{90}	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Roanoke River: John H. Kerr Reservoir & Dam, Va	—	3	6	9	0	0	0
Sabine River: Ruliff, Tex	—	4	5	9	—	—	—
San Juan River: Shiprock, N. Mex	—	44	42	86	6	8	14
St. Lawrence River: Massena, N. Y	—	4	7	11	—	—	—
Schuylkill River: Philadelphia, Pa	—	0	16	16	—	—	—
Savannah River:							
Port Wentworth, Ga	0.4	6	56	62	0	0	0
North Augusta, S. C	—	2	6	8	0	0	0
Shenandoah River: Berryville, Va	—	2	14	16	<1	1	1
Snake River: Wawawai, Wash	0.3	4	18	22	0	1	1
South Platte River: Julesburg, Colo	0.7	27	63	90	4	30	34
Susquehanna River:							
Sayre, Pa	0.3	6	11	17	0	0	0
Conowingo, Md	0.3	5	5	10	0	0	0
Tennessee River:							
Pickwick Landing, Tenn	—	0	33	33	1	0	1
Chattanooga, Tenn	0.6	2	14	16	—	—	—
Bridgeport, Ala	0.7	3	17	20	0	0	0
Tombigbee River: Columbus, Miss	—	3	6	9	0	0	0
Truckee River: Farad, Calif	—	9	17	26	0	0	0
Yakima River: Richland, Wash	0.4	6	18	24	0	1	1
Yellowstone River: Sidney, Mont	—	43	16	59	—	—	—

[a] Dash denotes no sample received or no determinations made.
[b] April–September strontium-90 data.

greater percentage of increase in the radioactivity is in the suspended solids.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network has been composited into a three-month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determination varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers, determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R., the gross beta and alpha determination schedules were altered. Beginning September 1, 1961, gross beta determinations are to be made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Beginning October 1, 1961, gross alpha determinations are to be made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all data reported for the period indicated. The reported strontium-90 data are the results of determinations on three-month

composite samples for the quarter ending in the month shown.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167–169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," *Journal of the American Water Works Association, 51*, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," *Journal of the American Water Works Association, 52*, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

(6) Straub, C. P., "Significance of Radioactivity Data," *Journal of the American Water Works Association, 53*, 704 (1961).

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, OCTOBER 1961

Monitoring of Water Supplies Around the Nevada Test Site

U.S. Atomic Energy Commission

By contract with the Atomic Energy Commission the Public Health Service has conducted an off-site monitoring program around the Nevada Test Site (NTS) since 1955. Included in the program have been measurements of radioactivity in water supplies. These data have been reported in the Atomic Energy Commission's 13th, 14th, 18th and 23rd Semiannual Reports to Congress and by the Public Health Service in the 1957 Congressional Hear-

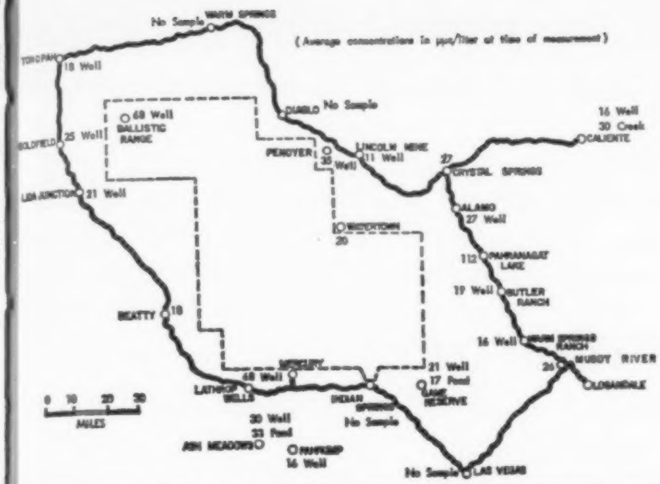

FIGURE 1.—GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE FOR NOVEMBER 1961

ings, "The Nature of Radioactive Fallout and Its Effects on Man."

Figure 1 summarizes gross beta measurements in water supplies located in the NTS off-site area for November 1961.

The lower limit of detectability with the equipment used is about 10 micromicrocuries per liter.

TABLE 1.—DESCRIPTION OF WATER-SAMPLING POINTS, NEVADA TEST SITE

Location	Source	Population served
Las Vegas	13 wells—650 to 1,250" depth plus Lake Mead supply	40,000.
Game Reserve	400' drilled well	20.
Indian Springs	600' drilled well	Average 250.
Pahrump	75' driven well	10–50.
Ash Meadows	Spring 25' deep	8.
Lathrop Wells	3 wells—600' deep	Average 15.
Beatty	Spring	550.
Lida Junction	125' drilled well	2–10.
Goldfield	Spring	Average 200.
Tonapah	2 drilled wells—60' depth	Average 1,500.
Warm Springs	Multiple springs—no improvement	10.
Diablo	Well	State Highway Station.
Lincoln Mine	2 driven wells	3.
Caliente	Springs	Average 10–12.
Crystal Springs	Free flowing spring	0.
Alamo	2 wells—50–67' deep	Average 175.
Pahranagat Lake	Surface	Not used for domestic purposes.
Butler Ranch	Flowing spring	1.
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool.
Logandale	Drilled well	300.
Ballistic Range	Drilled well	10–15.

SECTION V. — OTHER DATA

External Gamma Activity

Division of Radiological Health, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise, but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following table are within the variance anticipated due to differences in normal background and instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, JANUARY 1962

Station location		Average (mr hr)	Station location		Average (mr hr)
City	State		City	State	
Adak	Alaska	0.01	Lansing	Mich	0.02
Anchorage	Alaska	0.01	Minneapolis	Minn	0.01
Attu	Alaska	0.01	Jackson	Miss	0.01
Cold Bay	Alaska	0.01	Pascagoula	Miss	—
Fairbanks	Alaska	0.01	Jefferson City	Mo	0.01
Juneau	Alaska	0.02	Helena	Mont	0.03
Kodiak	Alaska	0.01	Lincoln	Nebr	0.01
Nome	Alaska	0.01	Trenton	N. J	0.02
Point Barrow	Alaska	0.01	Santa Fe	N. Mex	—
St. Paul Island	Alaska	[a] —	Albany	N. Y	0.02
Phoenix	Ariz	0.02	New York	N. Y	—
Little Rock	Ark	0.01	Gastonia	N. C	0.02
Berkeley	Calif	0.01	Bismarck	N. Dak	0.01
Los Angeles	Calif	—	Columbus	Ohio	0.01
Denver	Colo	0.02	Oklahoma City	Okla	0.02
Hartford	Conn	0.01	Ponca City	Okla	0.04
Washington	D. C	0.02	Portland	Oreg	0.02
Jacksonville	Fla	0.01	Harrisburg	Pa	0.01
Miami	Fla	0.01	San Juan	P. R	—
Atlanta	Ga	0.03	Providence	R. I	0.02
Agana	Guam	0.02	Columbia	S. C	0.02
Honolulu	Hawaii	0.02	Pierre	S. Dak	0.02
Boise	Idaho	0.02	Nashville	Tenn	0.01
Springfield	Ill	0.01	Austin	Tex	0.01
Indianapolis	Ind	0.01	El Paso	Tex	0.02
Iowa City	Iowa	0.03	Salt Lake City	Utah	0.02
Topeka	Kans	0.02	Richmond	Va	0.01
Frankfort	Ky	0.01	Seattle	Wash	0.01
New Orleans	La	0.02	Madison	Wis	0.02
Augusta	Maine	0.02	Cheyenne	Wyo	0.02
Baltimore	Md	0.02	Sundance	Wyo	—
Lawrence	Mass	0.02			

[a] Dash indicates no data received.

Byproduct Material Licensees

Division of Licensing and Regulation, U.S. Atomic Energy Commission

The Atomic Energy Commission periodically makes available tabulations of their byproduct material licensees giving the locations and types of licensees. The tabulation, as of December 1961, is presented in table 1. "Byproduct material" is defined as any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to radiation incidental to the processes of producing or utilizing special nuclear materials.

TABLE 1.—LOCATION AND TYPE OF BYPRODUCT MATERIALS LICENSEES, DECEMBER 1961

State or territory	Medical Institutions and Physicians			Colleges and Univ.	Industrial Firms		Federal and State Laboratories		Foundations and Institutes	Other	Sum of totals
	Private practice	Other	Total		Industrial radiography	Total	Civil defense	Total			
Alaska	1	1	2	1	0	0	5	10	0	0	13
Alabama	22	17	39	4	8	19	9	16	1	0	79
Arizona	14	8	22	3	1	8	16	18	0	1	52
Arkansas	13	8	21	1	0	9	2	2	0	0	33
California	213	119	332	18	47	246	21	65	3	9	673
Colorado	10	22	32	7	5	30	25	31	1	3	104
Connecticut	18	19	37	6	13	49	11	16	1	1	110
Delaware	1	3	4	1	2	12	6	6	0	0	23
Dist. of Col	12	16	28	4	2	7	17	33	2	2	76
Florida	54	30	84	5	8	22	26	32	0	1	144
Georgia	21	23	44	5	6	11	16	20	0	0	80
Hawaii	12	4	16	1	2	8	2	5	1	0	31
Idaho	3	3	6	2	3	3	1	2	0	0	13
Illinois	42	91	133	7	18	129	36	44	5	3	321
Indiana	29	29	58	9	14	47	18	18	0	3	135
Iowa	26	23	49	12	4	12	24	25	0	1	99
Kansas	10	16	26	3	6	18	19	20	0	0	67
Kentucky	18	14	32	4	3	14	19	23	0	0	73
Louisiana	17	22	39	6	14	32	9	11	2	1	91
Maine	6	11	17	2	2	7	3	4	0	1	31
Maryland	17	21	38	7	7	24	19	32	2	1	104
Massachusetts	27	54	81	20	15	109	19	24	6	3	243
Michigan	47	59	106	11	16	56	43	52	2	2	229
Minnesota	20	26	46	14	6	23	110	111	0	0	194
Mississippi	7	7	14	3	4	9	9	10	0	0	36
Missouri	39	44	83	6	8	32	29	31	0	1	153
Montana	4	9	13	3	0	3	1	2	0	0	21
Nebraska	10	11	21	2	1	4	27	27	0	1	55
Nevada	4	3	7	1	1	5	4	5	0	0	18
New Hampshire	2	10	12	4	2	7	9	11	0	0	34
New Jersey	60	49	109	2	23	140	25	31	2	2	286
New Mexico	10	8	18	6	1	16	2	8	0	0	48
New York	177	171	348	38	31	215	50	67	12	10	690
North Carolina	30	23	53	7	0	17	45	49	0	1	127
North Dakota	5	3	8	2	1	2	8	9	0	0	21
Ohio	75	75	150	14	36	124	49	60	3	2	353
Oklahoma	30	14	44	5	10	32	13	15	1	0	97
Oregon	20	12	32	7	7	11	33	36	1	0	87
Panama	0	1	1	0	0	0	0	0	0	0	1
Pennsylvania	47	95	142	20	56	174	105	121	6	4	467
Puerto Rico	4	5	9	3	1	3	2	2	0	0	17
Rhode Island	2	6	8	4	1	8	5	6	0	0	26
South Carolina	12	7	19	3	3	6	11	14	0	0	42
South Dakota	9	8	17	4	0	2	11	11	0	0	34
Tennessee	20	22	42	5	4	30	11	13	0	1	91
Texas	114	58	172	20	38	122	36	44	4	2	364
Utah	1	8	9	4	3	16	11	15	0	0	44
Vermont	7	4	11	2	0	3	1	1	0	0	17
Virginia	13	24	37	7	7	37	11	21	0	1	103
Washington	25	18	43	9	9	22	33	38	1	0	113
West Virginia	14	11	25	2	2	18	38	41	0	0	86
Wisconsin	25	39	64	6	17	37	4	6	3	1	117
Wyoming	1	3	4	1	1	7	13	15	0	2	29
Total	1420	1387	2807	343	469	1997	1072	1329	59	60	6595

Cesium-137 Levels in Humans

Walter Reed Army Institute of Research, Washington, D.C., and U.S. Army Medical Research Unit, Landstuhl, Germany

The whole body counting facilities at the Walter Reed Army Institute of Research (WRAIR), Washington, D. C., and the Medical Research Unit, Landstuhl, Germany, have continued their program for measuring the levels of cesium-137 in people. A description of each facility and previous data were summarized in *Radiological Health Data,* Vol. II, Nos. 4, 7, and 10; subsequent data appeared in Vol. III, No. 1.

This report presents results from Germany for the period September through November 1961, and from Walter Reed for the fourth quarter of 1961. The Landstuhl data are listed by month in table 1 and the Walter Reed data are listed by geographic area in tables 2 and 3.

TABLE 1.—ASSAYS PERFORMED AT THE UNITED STATES ARMY MEDICAL RESEARCH UNIT, LANDSTUHL, GERMANY

Date	Subjects residing in	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
September 1961	West Germany	595	33
October 1961	West Germany	452	34
November 1961	West Germany	587	28

TABLE 2.—ASSAYS PERFORMED AT THE WALTER REED ARMY INSTITUTE OF RESEARCH, FOURTH QUARTER 1961

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Canada	2	21
Central America	1	24
Europe	14	36
Far East	9	19
United States	80	24

TABLE 3.—ASSAYS OF INDIVIDUALS RESIDING WITHIN THE UNITED STATES PERFORMED AT WRAIR, FOURTH QUARTER 1961

State	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Alaska	2	43
Arizona	1	17
California	7	17
Colorado	1	20
Connecticut	1	31
Delaware	1	24
District of Columbia	4	26
Florida	1	35
Georgia	2	23
Idaho	1	18
Indiana	1	1
Iowa	1	25
Maryland	8	10
Massachusetts	1	52
Michigan	3	14
Minnesota	1	32
Mississippi	2	32
Missouri	1	12
New Hampshire	1	48
New Jersey	1	4
New Mexico	1	25
New York	7	26
North Dakota	3	30
Oklahoma	1	15
Pennsylvania	10	33
South Dakota	2	31
Texas	5	17
Virginia	8	23
Washington	1	19

TABLE 4.—SUMMARY OF TABLES 1 AND 2—FOURTH QUARTER, 1961

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)	Percent MPC[a]
Canada	2	26	0.13
Central America	1	24	0.12
Europe	14	36	0.18
Far East	9	19	0.10
United States	80	24	0.12
West Germany	1634	[b] 32	0.16

[a] *Radiological Health Data,* Volume II, Number 4, pages 193 nd 194.
[b] Values represent determinations for September through November 1961.

Survey of Radioactivity in Animal Feeds

Food and Drug Administration

A part of the continuing surveillance of radioactivity in foods by the Food and Drug Administration is concerned with the levels of strontium-90 in animal feeds. Table 1 presents the results of analyses of feeds collected during 1960 by representatives of the Food and Drug Administration Districts. This data indicates that hays and alfalfas continue to show relatively high strontium-90 content. Previous data for 1958, 1959, and 1960 have been presented in the May and December 1960 and the September and December 1961 *Radiological Health Data.*

TABLE 1.—STRONTIUM-90 CONTENT OF ANIMAL FEEDS

[Concentrations in $\mu\mu c$/kg original material]

Product	Origin		Harvest date	Strontium-90
	County	State		
Lespedeza hay	Barry	Missouri	1960	900
Lespedeza hay	Ross	Ohio	September 1960	260
Lespedeza hay	Cherokee	Kansas	July, September 1960	45
Alfalfa	Howard	Indiana	June 1, 1960	204
Alfalfa	Cherokee	Indiana	September 1, 1960	370
Dried beet pulp	Saginaw	Michigan	September, October 1960	32
Dried beet pulp	Monterey	California	October 10, 1960	36
Cotton seed meal	Wake	North Carolina	1959	4.6
Sorghum forage	Labett	Kansas	1960	34

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of the respective installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Bettis Atomic Power Laboratory and Shippingport Atomic Power Plant, for the first and second quarters of 1961.

The measured concentration of a radioactive substance in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards Handbook 69.

For the purpose of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 should be consulted.

The establishment of MPC's does not imply that each nuclide may be permitted to be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, the sum of all the percent values should not exceed 100%.

In the following reports, the use of nonspecific terms as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low, a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's reported by the laboratory.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line No.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, Ra^{223}, Ra^{226}, Ra^{228}, Pa^{231}, and Th-nat are not present[1]	2,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[1]	600	—
3	If Ra^{226}, Ra^{228} are not present[1]	100	—
4	Mixture of unidentified nuclides	10	0.0
5	If α emitters and Ac^{227} are not present[1]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[1]	—	10
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[1]	—	100
8	Hydrogen-3 (tritium)	3,000,000	200,000
9	Strontium-90	100	10
10	Xenon-133	—	300,000

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

Bettis Atomic Power Laboratory

Westinghouse Electric Corporation, Pittsburgh, Pennsylvania
First and Second Quarters 1961

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	November 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	October 1961

The Bettis Atomic Power Laboratory (BAPL), operated for the Atomic Energy Commission by Westinghouse Electric Corporation, was established in 1949. Since that time BAPL has been engaged in research and development work related to naval atomic propulsion systems and the central station atomic power reactor at Shippingport, Pennsylvania.

Liquid Radioactive Waste Disposal

The liquid effluent from the Laboratory is sampled continually and a composite sample is collected and analyzed weekly. This effluent includes the discharge from the Laboratory storm drainage system so that it may include some activity from fallout. The average concentrations of gross radioactivity and strontium-90 are presented in table 2.

Beta-Gamma Background Levels

Beta-gamma background levels are continuously monitored and recorded at a monitoring station located inside the western boundary of the laboratory property as shown in figure 1.

TABLE 2.—RADIOACTIVITY IN LIQUID WASTES

[Average concentrations in $\mu\mu c$/liter]

Type of activity	First quarter 1961	Second quarter 1961
Gross activity[1]	550	490
Strontium-90[2]	<1	<1

[1] For the environmental MPC used here for gross activity, see line 1 in table 1.
[2] The Sr^{90} concentration for the fourth quarter 1960, reported in the October 1961 *Radiological Health Data* should be changed from 14 to 0 $\mu\mu c$/liter.

The first and second quarter averages, 0.01 and 0.018 millirads per hour respectively, may be compared with the 0.01 to 0.04 mr/hr range measured throughout the United States by the

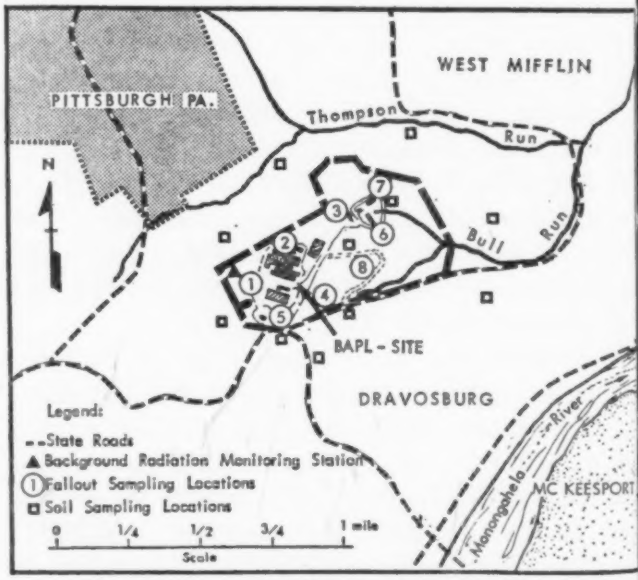

FIGURE 1.—BETTIS ATOMIC POWER LABORATORY SAMPLING STATIONS

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TABLE 3.—AVERAGE BETA ACTIVITY IN FALLOUT

[Average deposition rates in mc/km²/mo]

Station number (See figure 1)	First quarter 1961	Second quarter 1961
Upwind:		
1	1.5	3.5
5	2.0	3.5
Downwind:		
2	2.0	4.2
3	2.0	4.6
4	1.5	5.0
6	2.0	4.2
7	2.0	4.2
8	1.5	3.9

Radiation Surveillance Network, Public Health Service during March 1961.

Fallout

Monthly fallout samples are collected at the eight stations shown in figure 1. Due to the locations of the stations the measured activity may include both fallout from the atmosphere and activity resuspended because of the movement of vehicles and construction work. The results presented in table 3 reveal no substantial differences between upwind and downwind fallout rates.

Soil Sampling

Soil samples are collected during the second and fourth quarters each year. Beginning with the second quarter 1961 the number of sampling locations were increased from five to eleven as shown in figure 1. The second quarter average concentrations in soil based on the eleven samples were 87 $\mu\mu c$ α/gm and 23 $\mu\mu c$ β-γ/gm. Based on the original five stations the average concentrations were 70 $\mu\mu c$ α/gm and 19 $\mu\mu c$ β-γ/gm.

Shippingport Atomic Power Station

Duquesne Light Company, Shippingport, Pennsylvania
First and Second Quarters 1961

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959	July 1960
First quarter 1960	December 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	October 1961

The Shippingport Atomic Power Station operated for the Atomic Energy Commission by the Duquesne Light Company, is the world's first large-scale nuclear-powered electric generating station. The environmental radiation monitoring program was initiated two years prior to the beginning of plant operation in December 1957.

Release of Radioactive Wastes to the Atmosphere

During the second quarter 1961 a total of 84.9 millicuries of gaseous radioactive wastes (primarily xenon-133) was released to the atmosphere at a controlled rate over a period of 566 hours. This gaseous waste had an average concentration of 9,800 $\mu\mu c/m^3$ at the stack exit during release.

An incinerator for burning contaminated combustible material is located in the waste disposal plant. The exhaust from the incinerator passes through a wet gas scrubber and a filter before entering the stack.

During the first quarter 1961 the incinerator was operated on three occasions. The average radioactivity at the stock during operation was 34 $\mu\mu c/m^3$ (compare with table 1 line 7). The incinerator was not used during the second quarter 1961. Plans were under way to process and package all combustible radioactive wastes for shipment to Oak Ridge, Tennessee, for land burial.

Area Monitoring

Continuous weekly samples of airborne particulates are collected at four area monitoring stations shown in figure 2. Average concentrations of radioactivity in air for the first and second quarters 1961 are presented in table 4. These concentrations may be compared with table 1 line 7.

Beta-gamma radiation levels are also con-

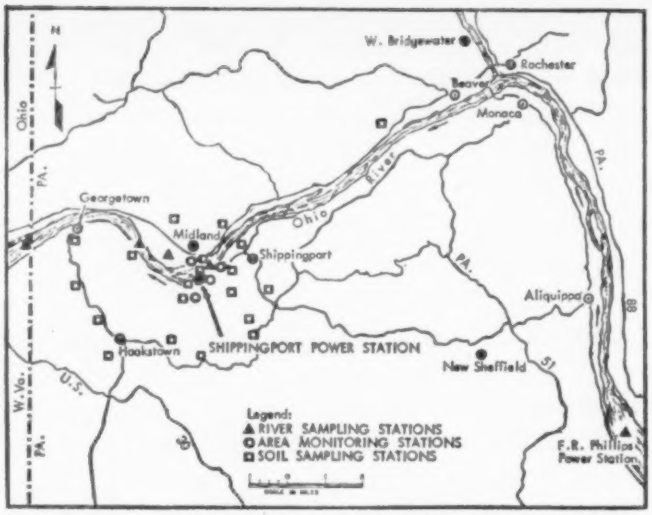

FIGURE 2.—SHIPPINGPORT POWER STATION, SAMPLING LOCATIONS

tinuously monitored at the four area monitoring stations. There was no significant difference in average levels among the four stations. The average beta-gamma level for each of the first two quarters of 1961 was 0.012 mrem/hr.

Weekly fallout samples are collected at the four area monitoring stations. The gross beta activity in fallout for the first and second quarters 1961 is given in table 5.

Liquid Radioactive Waste Monitoring

Tritium (H^3) is released periodically in controlled quantities and concentrations to the Ohio River. Toward the end of 1960 the ion exchange resin in the reactor coolant purification system was changed from a natural lithium hydroxyl form to a lithium-7 enriched form. This change has resulted in a decrease in tritium production within the reactor by a factor of about 30. The total tritium activities released to the Ohio River during the fourth quarter 1960 and first and second quarters 1961 were 51.3, 10.7, and 1.5 curies respectively. The average tritium concentrations in the plant effluent channel during tritium discharge were 7,200, 4,300, and 170 μμc/liter for the same three quarters.

Gross radioactivity of unidentified nuclides (does not include tritium) discharged during the first and second quarters 1961 totaled 23.7 and 22.0 millicuries respectively. Average concentrations in the effluent channel during release were 4.3 and 2.2 μμc/liter. These concentrations are in addition to normal background radioactivity in the condenser cooling water used for dilution in the effluent channel prior to dischage to the Ohio River. Although the Plant has conservatively adopted the most restrictive MPC as its guide (see table 1 line 4), a less restrictive guide as in table 1 line 3 could be justified on the basis that radium-226 and radium-228 should not be expected from the type of operation at Shippingport.

Continuous weekly water samples are collected from four locations on the Ohio River, and a weekly grab sample is taken at dam #7. The stations are listed by name in table 6 and their locations shown in figure 2. The beta activity given in table 6 includes naturally-occurring potassium-40 which averaged 2.1 and 1.1 μμc/liter in the Ohio River during first and second quarters 1961 respectively.

TABLE 4.—AIRBORNE PARTICULATE RADIOACTIVITY

[Average concentrations in μμc/m³]

Sampling location	First quarter 1961	Second quarter 1961
Upwind:		
½ mi. SW of site	1.1	1.0
½ mi. NW of site	1.0	No data
Downwind:		
On site, SE of main bldg	0.7	0.6
½ mi. NE of site	1.1	1.0
Average of all stations	1.0	0.9

TABLE 5.—GROSS BETA ACTIVITY IN FALLOUT

[Average concentrations in mc/km²/month[a]]

Sampling location	First quarter 1961	Second quarter 1961
Upwind:		
½ mi. SW of site	1.2	0.6
½ mi. NW of site	1.5	1.0
Downwind:		
On site, SE of main bldg	1.3	0.8
½ mi. NE of site	1.7	0.8
Average of all stations	1.4	0.8

[a] One mc/km² = 2.59 mc/mi².

TABLE 6.—GROSS ALPHA AND BETA CONCENTRATIONS IN THE OHIO RIVER

[Average concentrations in μμc/liter]

Sampling station	First quarter 1961		Second quarter 1961	
	Alpha	Beta	Alpha	Beta
Upstream:				
Phillips Power Station	0.9	7.1	1.2	9.2
Shippingport intake	1.0	7.4	[a] 1.5	6.9
Downstream:				
Shippingport outfall	1.0	15.9	[a] 1.4	8.3
Midland intake	1.5	11.8	1.1	8.4
Dam No. 7	[a] 1.0	8.4	[a] 1.4	7.8
East Liverpool, Ohio	1.6	8.8	0.7	6.8

[a] Weekly grab sample averages.

Reported Nuclear Detonations

Radiological Health Data, Volume II, Numbers 10, 11, and 12, and Volume III, Numbers 1, 2, and 3, published summary information on the Union of Soviet Socialist Republics and the United States reported nuclear detonations through February 28, 1962. The following table gives information on the subsequent tests reported through March 31, 1962. Low yield range has been announced as meaning about a nominal (20 kiloton yield); low-intermediate to mean between a nominal and one megaton yield.

NUCLEAR TEST DETONATIONS REPORTED DURING MARCH 1962

Test number	Location	Date	Size	Type of test
20	Nevada Test Site	March 5	Low yield	Underground
21	Nevada Test Site	March 6	Low yield	Underground
22	Nevada Test Site	March 8	Low yield	Underground
23	Nevada Test Site	March 15	Low yield	Underground
24	Nevada Test Site	March 28	Low yield	Underground
25	Nevada Test Site	March 31	Low yield	Underground

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